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TABLE MOUNTAIN.

L. H. MAXWELL.

TWO of the most important features of the Jura-Trias Period in America, in a geologic point of view, were the formation of the beds of red sandstones along the Connecticut river, and the upheaval of the Sierra Nevada mountain system. These sandstones of the Connecticut, made famous by the untiring researches of Dr. Hitchcock, are almost destitute of fossils, but abound in great numbers of tracks of many different animals. At the time when this sandstone was forming, an arm of the sea extended up the present valley of the Connecticut for a distance of one hundred and fifty miles or more. During low tide this sand-covered depression was invaded by various reptiles and other animals in search of food. The waters again advancing and carrying sediment, the tracks of the animals were covered by the mud and sand, in which state the deposits hardened into stone.

It was during this same epoch, or probably a little later, that the present site of the Sierra Nevada Mountains, which was then below the sea, the eastern shore of the Pacific being then the western part of the Great Western Plateau, was receiving the sedimentary deposits which now characterize the whole range and the basin to the west. When the mountains were upheaved, which event occurred during this same age, it left their surface for the most part covered to a greater or less depth with disintegrated granitic sandstone and other sedimentary deposits. Subsequent erosion has, to a great extent, given to these mountains their present interesting and beautiful appearance, wearing down the canyons and gulches, and leaving us the many thousands of foot hills, or low, individual eminences detached from the main mountain range, which stand on the borders of the California basin.

Among these foot hills where they border the plain, along the course of the San Joaquin as it leaves the western declivity and enters the San Joaquin valley proper, is found the Table Mountain that has excited the interest of those of an inquiring turn of mind who have seen it. Though now in detached portions caused by the erosion of the waters of the San Joaquin, and probably from glacial causes, it still presents a most instructive sight to geology students. Most of the detached tables stand out in relief from the foot hills, and some of them are several miles in length. The mountain is undoubtedly of volcanic origin, the rocks all being scoriaceous. It is the general conclusion that in the eruption of a volcano several miles back in the foot-hills, the vesicular lava flowed down the old bed of the San Joaquin. The basalt giving the present outline to the mountain is the result of the hardening of this augitic lava. In the course of ages, erosion carried away the surreunding deposits composing the former banks, leaving the volcano's work prominent and alone.

The height of the mountain above the river's level is near a thousand feet at its highest, but the river has worn down several hundred feet below its old bed when the mountain was formed, so that the thickness of the scoriac rocks is between two and three hundred feet. The walls of the tables are nearly everywhere perpendicular, making it oftentimes difficult to find a place of ascent on any of the detached portions.

With a friend I mounted one of the loftiest tables, about a half a mile in extent, and, in width, several hundred yards. It appeared to occupy the place of what may, before the eruption, have been a gulch, or a slough leading out from the river. Up this arm the melted rock was forced, in instances piling the black scoriae into promiscuous heaps on the side of the gulch. Indeed, from all appearances of the rocks in their present condition, when the lava cooled in flowing to lower levels, by its contraction it assumed the appearance of columnar structure, but these columns are not detached, though apparently so.

The tops of all the tables are comparatively level, but often near the outer edges may be found great heaps of volcanic rocks that are oblong in shape, and are disunited. They present an analogous appearance to the effects of the great flow of ice in some of the northern and eastern rivers oftentimes, when great gorges will pile the ice cakes out upon the shore in indiscriminate confusion, high above the water level. These scoriaceous rocks were most likely thrust out in this manner, the great force breaking them as ice is broken.

From the summit of any of these tables a splendid view may be had of the San Joaquin valley and the contiguous hills which stretch away to the south and to the north for hundreds of miles, with their sugar loaf shape presenting a beautiful panorama, being covered with grass, and almost entirely destitute of trees or brush.

The auriferous states in a metamorphic condition, of both sides of the Sierras, were the product of the Jura-Trias Period. Long before Table Mountain was formed, the San Joaquin was carrying down its current disintegrated granitic rocks and auriferous slates, the latter rich in the precious metal; so now, under the cap of igneous rock which forms the surface of the mountain, in the old bed of the stream, are the remains of some of the richest of placer mines. At the head of this frozen current of lava may be distinctly seen the traces of the old volcano that emitted such a quantity of melted rock, being, at a rough estimate, 1,056,000,000 cubic yards.

The Sierra Revolution, as some geologists term the period in which these mountains were formed, has been most free in its distribution of natural scenery. What with Yosemite Valley, Table Mountain, Kings River Canyon, its great forests of fine timber, including the famous big trees, and the prominence of such snow-capped peaks as Mt. Whitney and Mt. Tyndall, not to mention the gold and the other fields of precious metals, and the thousand other places and features interesting and valuable to man, the Sierra Nevada Mountains deserve to give name to that period in which they were produced. The geology, flora, and meteorology of California, as well as its social and moral fabric, belong peculiarly to the Golden State, in which respects it is as much an individuality as any portion of our country may be, and still be an integrant part of the whole. Such institutions as the California University and the Stanford University have fine opportunities to study Nature in the Pacific Slope's most interesting display.

HOW LONG CAN THE EARTH SUSTAIN LIFE?

Sir Robert Ball.

(*In Two Parts. Part II.*)

IT was long a mystery how the sun was able to retain its heat so as to continually supply its prodigious rate of expenditure. The suppositions that would most naturally occur were shown to be utterly insufficient. We know that a great iron casting often takes many hours to grow cold after it has been drawn from the mould. If the casting be a sufficiently large one, the cooling will proceed so slowly that it will not get cold for days because the tardiness of cooling increases with the dimensions of the body. It was not, perhaps, unnatural to suppose that as the sun was so vast the process of cooling would proceed with such extreme slowness that notwithstanding the quantity of heat poured out every second, the annual amount of loss would be so small relatively to the whole store that the effect of that loss would be imperceptible in such periods as those over which our knowledge extends. This supposition, however plausible, is speedily demolished when brought to the test by which all such questions must be decided—the test of actual calculation. We can determine with all needful accuracy the store of heat that the sun would contain if regarded merely as a white hot solid globe. When we apply the known annual loss, we see at once that if the sun had merely the simple constitution here supposed, the annual expenditure would bear such a considerable proportion to the total supply that the effect of the loss would become speedily apparent. It is certain that the sun must under such circumstances fall some degrees in temperature each year. In a couple of thousand years the change in temperature would be sufficiently great to affect in the profoundest manner the supply of sunbeams. As, however, we know that for a couple of thousand years, or, indeed, for periods much longer still, there has been no perceptible decrease in the volume of solar radiations, we conclude that the great luminary cannot be regarded merely as a glowing solid globe dispensing its heat by radiation. There is another supposition as to the continuance of sun heat which must be mentioned only, however, to be dismissed as quite incapable of offering any solution of the problem. As we generate heat here so largely by the combination of fuel, it has been sometimes thought that a similar process may be in progress on the sun. It has been supposed that elements capable and desirous of chemical union may exist in the sun in such profusion that by their entering into association a quantity of heat is liberated sufficient to account for the continuous dispersal by radiation. Here, again, the test must be applied which is decisive of such pretensions. It may certainly be the case that chemical actions of one kind or another are going on in the sun, and among them are doubtless some of such a character that they evolve heat. But we happen to know exactly how much heat can be evolved by the action of specified quantities of elementary bodies by whose union heat is generated. It appears clear from the figures that chemical action is a wholly inadequate method of accounting for solar radiation. To take one instance, we may mention that if the sun had been a globe of white-hot carbon, and if there had been a sufficient supply of oxygen to effect its combustion, the total heat generated by the entire mass would not supply the solar radiation for the period that has elapsed since the building of the pyramids. It is, therefore, clear that the supposition that the sun is a burning globe, like the supposition of the sun as a cooling solid globe, is quite inadequate to explain the marvellous persistence with which, for countless ages, the orb of day has distributed its beams.

There is another supposition which, though not itself providing the explanation that we are searching for, still points so far in that direction that I have kept it till the last. It has been sometimes suggested that the dashing of meteoric matter into the sun from outside may afford the requisite supply of energy. There can be no doubt that the plunge of a meteor into the sun's atmosphere with the terrific velocity which it will necessarily acquire in consequence of the attraction of the sun, is accompanied by the transformation of the energy of the meteor's movement into light and heat. The quantity of energy that a meteor thus carries with it is so vast that it is hardly credible until the figures which express it and the grounds on which they are based have received due attention. Let us think of a meteor which is moving, as such bodies do when near the earth, with a speed perhaps a hundred times as great as that of a bullet from a rifle, or even from one of the most finished pieces of artillery. The energy of the meteor, depending as it does upon the square of the velocity, will be, therefore, about ten thousand times that of the bullet of the same size. It seems that the energy thus possessed by a meteor one pound in weight is as much as could be developed by the explosion of a ton weight of gunpowder. Doubtless, in the vicinity of the sun, the meteors are more numerous, and they move with a higher velocity than the meteors near the earth. It is therefore plain that the quantity of energy contributed to the sun from this source must be large in amount. It can, however, be shown that there are not enough meteors in existence to supply a sufficient quantity of heat to the sun to compensate the loss by radiation. The indraught of meteoric matter may indeed certainly tend in some small degree to retard the ultimate cooling of the great luminary, but its effect is so small that we can quite afford to overlook it from the point of view that we are taking in this paper.

It is to Helmholtz we are indebted for the true solution of the long-vexed problem. He has demonstrated, in the clearest manner, where the source of the sun's heat lies. It depends upon a cause that, at the first glance, would seem an insignificant one, but which the arithmetical test, that is so essential, at once raises to a position of the greatest importance. It is sufficiently obvious that the sun is in no sense to be regarded as a solid body. It seems very unlikely that there can be throughout its entire extent any portion which possesses the properties of a solid; certainly those exterior parts of the sun which are all that are accessible to our observation are anything but solid: they are vast volumes of luminous material floating in gases of a much less luminous nature. The openings between the clouds form the spots, while the mighty projections which leap from the sun's surface testify in the most emphatic manner to the gaseous or vaporous character of the outer parts of the great luminary. A gaseous globe like the sun when it parts with its heat observes laws of a very different type from those which a cooling solid follows. As the heat disappears by radiation the body contracts; the gaseous object, however, decreases in general much more than a solid body would do for the same loss of heat. This is connected with a striking difference between the manner in which the two bodies change in temperature. The solid, as it loses heat, also loses temperature; the gas, on the other hand, does not necessarily lose temperature even though it is losing heat. Indeed, it may happen that the very fact that the gaseous globe is losing heat may be the cause of its actually gaining in temperature and becoming hotter. This seems a paradox at the first glance, but it will be found not to be so when due attention is paid to the different notions that belong to the words heat and temperature. The globe of gas unquestionably radiates heat and loses it, and the globe, in consequence of that loss, shrinks to a smaller size. The heat, or what is equivalent to heat, that is left in the globe, is exhibited in a body of reduced dimensions, and in that smaller body the heat shows to such advantage that the globe actually exhibits a temperature hotter than before the loss of heat took place. In the facts just mentioned we have an explanation of the sustained heat of the sun. Of course we cannot assume that in our calculations the sun is to be treated as if it were gaseous throughout its entire mass, but it approximates so largely to the gaseous state in the greater part of its bulk that we can feel no hesitation in adopting the belief that the true cause has been found. To justify the adequacy of this method of explaining the facts I may mention the following result of a calculation. If the sun were to lose sufficient heat to enable it to shrink in its diameter by one ten-thousandth part of its present amount, the quantity of heat that would be available in consequence of this contraction would suffice to provide the entire radiation for a period of 2,000 years. Such a diminution of the sun's bulk would be altogether too small to be perceptible by the most refined measurements that we can make in the observatory. Hence we are able to understand how the prodigious radiation of the sun during all the centuries of history can be accounted for without any alteration in the dimensions of the great luminary having yet become appreciable.

But there is a boundary to the prospect of the continuance of the sun's radiation. Of course, as the loss of heat goes on, the gaseous parts will turn into liquids, and as the process is still further protracted, the liquids will transform into solids. Thus we look forward to a time when the radiation of the sun can be no longer conducted in conformity with the laws which dictate the loss of heat from a gaseous body. When this state is reached the sun may, no doubt, be an incandescent solid with a brilliance as great as is compatible with that condition, but the further loss of heat will then involve loss of temperature. At the present time the body may be so far gaseous that the temperature of the sun remains absolutely constant. It may even be the case that the temperature of the sun, notwithstanding the undoubted loss of heat, is absolutely rising. It is, however, incontrovertible that a certain maximum temperature having been reached (whether we have yet reached it or not we do not know), temperature will then necessarily decline. There is certainly no doubt whatever that the sun, which is now losing heat, even if not actually falling in temperature, must, at some time, begin to lose its temperature. Then, of course, its capacity for radiating heat will begin to abate. The heat received by the earth from the great centre of our system must, of course, decline. There seems no escape from the conclusion that the continuous loss of solar heat must still go on, so that the sun will pass through the various stages of brilliant incandescence, of glowing redness, of dull redness, until it ultimately becomes a dark and non-luminous star. In this final state the sun will literally join the majority. Every analogy would teach us that the dark and non-luminous bodies in the universe are far more numerous than the brilliant suns. We can never see the dark objects, we can discern their presence only indirectly. All the stars that we can see are merely those bodies which at this epoch of their career happen for the time to be so highly heated as to be luminous.

There is thus a distinct limit to man's existence on earth, dictated by the ultimate exhaustion of the sun. It is, of course, a question of much interest for us to speculate on the probable duration of the sun's beams in sufficient abundance for the continued maintenance of life. Perhaps the most reliable determinations are those which have been made by Professor Langley. They are based on his own experiments upon the intensity of solar radiation, conducted under circumstances that give them special value. I shall endeavor to give a summary of the interesting results at which he has arrived.

The utmost amount of heat that it would ever have been possible for the sun to have contained would supply its radiation for 18,000,000 years at the present rate. Of course, this does not assert that the sun, as a radiant body, may not be much older than the period named. We have already seen that the rate at which sunbeams are poured forth has gradually increased as the sun rose in temperature. In the early times the quantity of sunbeams dispensed was much less per annum than at present, and it is, therefore, quite possible that the figures may be so enlarged as to meet the requirements of any reasonable geological demand with regard to past duration of life on the earth.

It seems that the sun has already dissipated about four-fifths of the energy with which it may have originally been endowed. At all events, it seems that, radiating energy at its present rate, the sun may hold out for 4,000,000 years, or for 5,000,000 years, but not for 10,000,000 years. Here then we discern in the remote future a limit to the duration of life on this globe. We have seen that it does not seem possible for any other source of heat to be available for replenishing the waning stores of the luminary. It may be that the heat was originally imparted to the sun as the result of some great collision between two bodies which were both dark before the collision took place, so that, in fact, the two dark masses coalesced into a vast nebula from which the whole of our system has been evolved. Of course, it is always conceivable that the sun may be re-invigorated by a repetition of a similar startling process. It is, however, hardly necessary to observe that so terrific a convulsion would be fatal to life in the solar system. Neither from the heavens above, nor from the earth beneath, does it seem possible to discover any rescue for the human race from the inevitable end. The race is as mortal as the individual, and, so far as we know, its span cannot under any circumstances be run out beyond a number of millions of years which can certainly be told on the fingers of both hands, and probably on the fingers of one.

—*Fortnightly.*

THE STORY OF THE ALAMO.

E. M. BARRER.

TEXAS stands unique in the composition of the Union as the one single independent Sovereignty which knocked at our governmental door for an unconditional admission to the sisterhood of the United States. She came of her own free choice bringing a territory which without crowding to the extent of more than seven or eight per acre would accommodate the population of the entire globe.

Forged in the furnace of wars and civil dissensions; her missions reared by the masonry of martyrs ; her soil soaked with the blood of her heroes—alone, she has bequeathed a heritage of heroism to the Federal Union which coming generations can count among the richest treasures of inherited American citizenship.

San Antonio–the Saratoga of the South–is the oldest of Texan cities and possesses historic and picturesque landmarks not approached by any other American city. Even the citizens of San Antonio do not appreciate what a source of pride these historical surroundings should furnish them, and are always more willing to point the Eastern visitor to the new Post-office or the Army Headquarters, than to solicit a trip to the grand old missions which if found in any other country than our own would be visited by multitudes of American tourists anxious to contrast the civilization of two centuries and prepared to fall down and worship such rare memorials of a heroic past. The Alamo is to Texas what Bunker Hill is to Massachusetts, but the pride of them both belongs to every American citizen from Maine to California. The battle of the Alamo was the decisive struggle which turned the tide toward Texan independence. It will be remembered that on the twenty-third of February, 1836, General Santa Anna, the self-styled "Napoleon of the West", marched into the town with 4000 Mexican soldiers. The Texan guard consisting of only one hundred forty-four effective fighting men, retired in good order to the Alamo under command of Colonel Travis, who, in anticipation of an attack, had done what he could to strengthen the walls and provide means of defense. The Alamo though strong was built for a mission and not a fortress. At that time the main enclosing wall was in the form of a rectangle one hundred ninety feet long and one hundred twenty-two feet wide. On the south-east corner was the church itself, which contained the arsenal and the soldiers' quarters. This building remains standing to-day and faces a plaza in the center of the city. It was in this structure that the massacre occurred. The walls were mounted with fourteen pieces of artillery commanding every approach. Santa Anna immediately demanded a surrender of the Alamo and its defenders, without terms. The demand was answered by a cannon-shot from the fort. The enemy then hoisted a blood-red flag in the town and commenced the attack. Travis sent off an express with the following appeal for aid :

"Fellow-Citizens and Compatriots—I am besieged by a thousand or more of the Mexicans under Santa Anna. I have sustained a continual bombardment and cannonade for twenty-four hours and have not lost a man. The enemy have demanded a surrender at discretion, otherwise the garrison is to be put to the sword, if the fort is taken. I have answered the summons with a cannon-shot, and our flag still waves proudly from the walls. I shall never surrender or retreat. Then I call on you in the name of liberty, patriotism, and everything dear to the American character to come to our aid with all dispatch. The enemy are receiving reinforcements daily, and will, no doubt, increase to three or four thousand in four or five days. Though this call may be neglected, I am determined to sustain myself as long as possible, and die like a soldier who never forgets what is due to his own honor and that of his country. Victory or death !

W. Barrett Travis."

But the hope of relief was faint indeed. For four days the defenders of the mission were living in the hope of re-inforcements, but neither couriers returned nor rescue came. On the fourth day Colonel Fannin with three hundred men and four pieces of artillery started forth from Giliad, but for lack of teams and provisions concluded to return. The garrison at the Alamo never knew of this attempt to relieve them. On the morning of the first of March Captain John W. Smith brought an offering of thirty-two men from Gonzales and succeeded in leading them safely into the fort. In the meantime there have been determined defense by day and skirmishes for food and water by night. Fifteen hundred of the enemy have fallen under the unerring aim of the Texas rifle, but not one inside the Alamo was killed. On the tenth day Bonham, who had been sent out for succor, failing in his efforts to secure assistance, heroically as ever mortal kept his faith, returns—to die. On the third day of March Major Rose, who could speak Spanish, trusted to this chance to escape, and scaling the walls dropped into a ditch on the other side and hidden by the cactus, crawled to a place of safety. Through him we have an account of what happened before the final day came. About two hours before sunset Colonel Travis paraded all his men, and taking his position in front of the centre, stood for some moments apparently speechless with emotion; then with a voice made eloquent by the heroism of the occasion, he addressed them substantially as follows:

"My Brave Companions—Stern necessity compels me to employ the few moments afforded me by this probably brief cessation of the conflict in making known to you the most interesting, yet the most solemn, melancholy and unwelcome fact that humanity can realize. Our fate is sealed. Within a very few days, perhaps a very few hours, we must all be in eternity! I have deceived you long by the promise of help; but I crave your pardon, hoping that after hearing my explanation you will not only regard my conduct as pardonable, but heartily spmpathize with me in my extreme necessity. I have continually received strongest assurance of help from home. Every letter from the council and every one that I have seen from individuals has teemed with assurances that our people were ready, willing and anxious to come to our relief. These assurances I received as facts. In the honest and simple confidence of my heart I have transmitted to you these promises of help, and my hope of success. But the promised help has not come and our hopes are not realized. I have evidently confided too much in the promises of our friends; but let us not be in haste to censure them. They were evidently not informed of our perilous condition in time to save us. Then, since we must die, our business is, not to make a fruitless effort to save our lives, but to choose the manner of our death. But three modes are presented to us; let us choose that by which we may best serve our country. Shall we surrender and be deliberately shot without taking the life of a single enemy? Shall we try to cut our way out through the Mexican ranks and be butchered before we can kill twenty of our adversaries? I am opposed to either method. Let us resolve to withstand our adversaries to the last, and at each advance to kill as many of them as possible, and when at last they shall storm our fortress, let us kill them as they come! Kill them as they scale our walls! Kill them as they leap within! Kill them as they raise their weapons and as they use them! Kill them as they kill our companions and as long as one of us remains alive! But I leave every man to his choice. Should any man prefer to surrender or to attempt an escape, he is at liberty to do so. My own choice is to stay in the fort, and there die for my country, fighting as long as breath shall remain in my body. This will I do even if you leave me alone. Do as you think best, but no man can fall with me without affording me comfort in the hour of death!"

Colonel Travis then traced a line on the ground with the point of his sword and requested those that were determined to remain and face with him the final ordeal, to cross that line. Tapley Holland leaped across it as though it were a Rubicon. "I am ready to die for my country," he said. He was followed by every man in the line, except Rose, who cleared the walls and miraculously escaped. Colonel Bowie (who gave his name to a knife), lying wounded in his cot, raised himself on his elbow. "Boys," he said, "don't leave me. Won't some of you carry me across?" All of the sick that were able to walk tottered across the line and those who were not able to walk were carried across. Here Davy Crockett, who had crossed over from his own state to help those who were freeing theirs, proved his own courage, and vindicated his fidelity to his own maxim—"Be sure you are right, then go ahead."

Three days later, at midnight of March 6th, Santa Anna issued peremptory orders to his reluctant officers and brought forward his infantry, pricked on by cavalry in the rear, the trumpet meanwhile sounding the *dequelo* ("Death! no quarter!"). The infantry came up on every side at once, but the brave band inside the mission drove them back. Blinded by the fury of the defense, the leaders with the scaling-ladders dropped them and ran against the bayonets of their comrades. A second time they charged but again they were driven back leaving as many dead at the foot of the ladders as there were men standing at bay within the walls. But at the third trial the ladders were planted and the Mexicans fell to their exterminating work. Hundreds of them met with bullets and bayonet-thrusts until the little band grew smaller and weaker. As Travis stood upon an angle of the northern wall, cheering the fearless souls around him, a ball struck his forehead. The Mexican officer who rushed forward to dispatch him paid the penalty with his life. Crockett fighting like a panther in the angle of the church, sent to their doom his share of the foe. Bowie—butchered on his bed—but his avenging arm was bathed deep in the assassin's blood. So they all died—the one hundred seventy-two men who held at bay four thousand Mexicans for two sleepless weeks were swept away in indiscriminate slaughter. The Mexicans opened the church door to their comrades who gazed upon one thousand twenty-two of their dead and wounded companions. Detestable alike in victory and defeat the inhuman conqueror ordered the incinerated remains of the dead defenders scattered to the four winds of Heaven.

The love of liberty linked itself with the soldier's shout and seven weeks afterward, Sam Houston with the battle-cry of "Remember the Alamo!" fell upon the Mexicans at San Jacinto and in eighteen minutes had laid half their number dead upon the field and made the other half prisoners, including Santa Anna himself.

Thus Texas had her Thermopylæ. The Alamo is the monument of its own massacre. The heroism of the ancients is again recorded and preserved in modern mnnuscript, and the youth of our own dear country here finds an example of unflinching patriotism inspiring a love for its wonderful past and a tender solicitude for its final destiny.

SCIENCE OF TO-DAY.

PRINCE KROPOTKIN.

I.

A BREATH of youthful energy and youthful hopes inspires modern astronomical work. "Astronomy, the oldest of the sciences, has more than renewed her youth." Since the spectroscope, formerly used but to study and reveal the chemical composition of the celestial bodies, has become an instrument for measuring their unseen movements and for penetrating into the secrets of their history, and since photography has been taken as a necessary auxiliary by astronomers, a new chapter of astro-physics has been opened. The proper movements of the stars have acquired a new meaning; the faint masses of nebulous matter, scattered round and amidst the stars, have become animated indications of the genesis of solar systems; and the great problems relative to the *life* of the stellar worlds—their origin, their growth, their decay, and their rejuvenescence—have come again to the front, supported by renewed hopes as to the proximity of their ultimate solution.

It is not possible, indeed, to examine the splendid photographs, made by Mr. Roberts, of the nebula in Andromeda, and to see this whirlpool of luminous matter, divided into dark and bright rings surrounding a large undefined central mass, without perceiving in it a gigantic solar system in the way of formation, and without concluding in favor of a similar origin, on a much smaller scale, of our own solar system. The best drawings of the same nebula, which were made by Bond and John Herschel with the aid of the best telescopes, told nothing of the kind; the complicated structure of the nebula, its life, were missing in what was reproduced by the pen of a cautious observer.

Again, in another part of the sky—the Pleiades—the photographs of the Brothers Henry show at once that this cluster of suns is not an occasional gathering. Streaks of nebulous matter, revealed by photography, connect together the stars of the group, and on examining the whole, one cannot refrain from concluding that the stars are simply spots upon which the diffuse nebulous matter has agglomerated and condensed to make new suns. The same is also seen in the photographs of the nebulæ in Orion—the more so as the spectroscope reveals the unity of composition of both the stars and the nebulæ which surround them and link them together.

Still more interesting results have been obtained by H. C. Russell with his photographs of nebulæ in the constellation of Argus. His earlier photographs, obtained by a three-hours' exposure, have already been referred to with admiration by William Huggins in his address. But when the photographic film was exposed for eight hours to the faint light of the nebula, new facts were revealed. The photograph not only shows that the nebulous matter extends far beyond the limits assigned to it by Herschel during his memorable observations at the Cape, while confirming at the same time the great accuracy of the description of what he did see; it also proves that the nebula has *lived* since 1837, and has altered considerably its aspect during the last fifty years. At the very same place where Herschel saw one of its brightest and most conspicuous parts, we have now a dark oval space, upon which no trace of luminous matter can be detected. The matter either has been drawn elsewhere, or is luminous no more; may be, it is passing through some stage preparatory to the appearance of a new star. We are thus convinced that these accumulations of matter, however gigantic their dimensions, are living at a much more rapid speed than we were prepared to admit. Changes occur in them, even within the short limits of one man's life; and as the new star in Auriga, rapidly passing through a series of transformations, reveals to us the secrets of the birth of new suns, so also we may hope that the study of the modifications of the nebulæ will initiate us into the secrets of the earlier stages of development of the stellar worlds. In the movements of those remote agglomerations we learn to feel the continuous life of Nature, its continuous change, its evolution.

When the great photographic map of the whole sky is ready, many a change in the stellar worlds and nebulæ which escapes now our attention will be recorded for ever. The preparatory work is already completed; the instruments are chosen, and the uniformity of methods is secured. The sky is apportioned between the eighteen observatories which will perform the whole of this immense work, each of them having to make from 1,000 to 1,500 separate photographs in order to map all stars down to the sixteenth magnitude; and the first specimens already published satisfy the most severe exigencies of the astronomers. Many new facts are sure to be revealed by this grand survey of the sky, because even now, when a simple preliminary exploration is being made, we can already mention some discoveries due to photography. Thus, when the amateur astronomer, Dr. Anderson (equipped with but a small pocket telescope and the little Atlas of the sky by Klein), discovered on the 31st of January the new star in Auriga, it appeared that the newcomer had already been photographed without astronomers being aware of the fact. Professor Pickering found its portrait on photographs taken on three different occasions since the 1st of December, and the indefatigable Heidelberg astronomer, Max Wolf, also had it on his photographs since the 8th of the same month. The appearance of the new star thus would have been recorded, even if nobody had remarked its appearance. Another photographic discovery is due to the same Max Wolf. Having photographed one part of the sky on two consecutive nights in December, he sent his negatives to Dr. Berberich, who at once noticed that two minute spots had changed their positions in the twenty-four hours. One of them proved to be a new addition to the list of minor planets, while the other was a previously known small planet of the same group.

However, the chief progress recently achieved in physical astronomy is due to the spectroscope, aided by photography. The spectra of the stars, the nebulæ, the corona and the protuberances of the sun, are now photographed; and by this means the powers of the astronomer are considerably extended. He can study the spectrum in its ultra-violet part, which is not visible to the eye, as it hardly acts upon our retina, while its chemical rays act very well upon the photographic sensitive plate; he obtains greater enlargements of the spectrum, and he can study the spectra at his leisure and measure the positions of the bright or dark lines which intersect them—the more so as the spectrum of some well-known body (incandescent hydrogen or iron) is photographed on the same plate for the sake of comparison. This method has already given some excellent results. It has permitted us to measure the movements of the stars in the line of vision with a quite unexpected accuracy. The proper movements of the stars offer an immense interest; but while we always could ascertain their movements north and south, or west and east, on the celestial sphere, we formerly had no means of telling whether a star is approaching us, or going away, during its displacements in space. The spectroscope gives those means. The spectrum of a star usually consists of a band of faint light, intersected by several bright (or dark) lines, corresponding to the lines appearing in the spectra of hydrogen, calcium, iron, magnesium, natrium, and so on. But if we reproduce under the spectrum of the star the spectrum of, say, hydrogen, we often see that the hydrogen lines in the former do not quite coincide with the same lines of the latter; they are slightly displaced to the right or to the left. William Huggins long ago explained that this displacement is due to the proper movements of the stars and gives a means of measuring them, and Mr. Christie even measured in this way, several years ago, the otherwise invisible movements of several stars. In fact, the blue and violet light of the spectrum is due to very quick luminous vibrations, while its red light is due to much slower vibrations, just as the high pitch of a sound depends on much quicker vibrations of the air than the low pitch. But if a star approaches us with a great rapidity, our eye will receive from it more vibrations in a secend, and its light will appear bluer, so to say; in other words, its spectral bright lines will be shifted towards the blue end of its spectrum; and they will be shifted towards the red end if the star goes away with the same rapidity. In our century of railways many of us must have witnessed an analogous fact when looking at an express train passing by a station. When the rapidly running engine sounds its whistle, the pitch of the whistle seems to become higher as the train approaches us, and it seems to become lower when it goes away—the ear receiving in a second of time more and more vibrations in the former case, and less vibrations in the second case. So it is also with the stars, and the advantages of having the spectrum of the star and the comparison spectrum photographed on the same plate are self-evident.

If we examine, for instance, the photographed spectra of Sirius we see that their hydrogen lines are always shifted towards the blue end of the spectrum, and from this we may safely conclude that the star is *approaching* us. And if we calculate the speed of its approach, we find it (after having taken into account the movement of the Earth in its orbit) to be about seven miles in a second. The measurements may be made at different observatories and at different seasons of the year; the final results will not differ from each other by more than one mile, or even a fraction of a mile. We do not know the immense distance which separates us from Sirius, we only gauge it by saying that its light takes nearly sixteen and a half years to reach us; but a change of *seven* miles per second in that enormous distance is revealed by the spectrum. These results seem almost incredible, and they could not be relied upon had they not been submitted to severe tests. Thus we know the movements of the Earth in its orbit, and we conclude that they must be reflected in our measurements, if these measurements are sufficiently accurate; and they *are* reflected with perfect accuracy. Again, we know the distance which separates us from Venus, and how the movements of both the earth and Venus affect this distance. We may calculate beforehand that at a given moment Venus will approach the Earth at a speed of 7.4 miles in a second; and when we determine the same speed with the aid of the spectroscope, we find 7.8 miles. The spectroscope, errs by but four-tenths of a mile —by less than 700 yards!

We may thus place full confidence in our new auxiliaries. When Mrs. Flemming and Miss Maury, on examining the spectrum of B Lyræ, remarked that it consists in reality of two spectra periodically superposed, and Professor Pickering concluded therefrom that the star must consist of two luminous bodies which rotate around a common centre of gravity at a very great speed, or when we are told that the new Auriga star consists of at least three separate agglomerations of incandescent gases, we can safely rely upon these conclusions.

And, finally, the spectroscope, combined with photography, enables us to explore the ultra-violet part of the spectrum quite invisible to the eye. By using this method, Hale at Chicago, and Deslandres at Paris, obtained day by day the position of those solar emissions of incandescent gas, or protuberances, which consist chiefly of incandescent hydrogen, and the light of which is so feeble that they escape observation, even during the eclipses of the sun, when its light is screened by the moon. The movements of these invisible clouds are now studied like the movements of our own atmosphere, and we learn that the laws of cyclonic storms which prevail on the earth hold good for the hot vapors of hydrogen and calcium on the surface of the sun. The unity of Nature and her laws thus receives a further brilliant confirmation.

II.

Another question which, although it has a direct bearing upon our own terrestrial affairs, preoccupies astronomers considerably, is the *variation of latitudes.* It has been remarked for some time since that Pulkova and Berlin change from year to year their geographical positions. Their latitudes decrease; every year the two observatories seem to move away from the North Pole by a few inches; and as they do *not* move in reality, there is no alternative but to conclude (after having tried all possible explanations) that the North Pole itself changes its position, although such a movement had been hitherto considered as most improbable by all scientists.

We all know— were it only from observations upon a spinning-top—that if a solid body is rotating, its axis may change its position in space, but that relatively to the rotating body itself it remains unchanged. A spinning-top may incline towards the floor, and its axis of rotation may describe a conical surface, but it does not alter its position *within* the top; each of the particles of the top describes the same circle round the same spot of the axis. The same was considered to be true as regards the earth. Its axis of rotation slowly changes its position in space; but within the earth itself, we were told, it remains unaltered. So that if two Arctic travellers attained the North and the South Poles, and erected two cairns upon these spots, the cairns would always represent the position of the axis of rotation of the earth. And yet recent observations tend to overthrow this view; we learn that the cairns must continually be shifted in order to represent the true position of the poles.

The importance of this discovery for the physical geographer is self-evident. The geologist has no means to explain by terrestrial causes alone two great geological facts of primary importance: the glaciation of the earth, and the extension, during the Tertiary epoch, of a very rich flowering and fruit-bearing vegetation, now characteristic of Southern Europe, over a wide continent which embraced Greenland, Spitzbergen, the Arctic islands of Siberia, and North America. If the simultaneous glaciation of both hemispheres be proved—and some specialists are of this opinion, while those who oppose it will confess that the whole question has not been studied sufficiently—it could not be explained by astronomical hypotheses implying the alternate glaciation of the two hemispheres. Nothing short of a decrease in the amount of heat received from the sun would give the explanation; but few astronomers would be prepared to make such an admission. As to the prevalence of a rich flora in Arctic regions which receive but a limited amount of heat, and especially light, it might be best explained by a change in the position of the earth's axis; but such a change was also considered until now as highly improbable.

Schiaparelli, the great Italian astronomer, fully grasped these weighty considerations, and they induced him to revise, a few years ago, the whole question as to the supposed invariability of the axis of rotation of the earth. He calculated the effects which slight displacements of matter on the earth's surface might have upon the position of the axis, and he demonstrated by mathematical analysis that slight but prolonged geological changes "may give origin to great displacements of the poles of rotation, provided the earth's spheroid is not of absolute rigidity."

The same position was taken by George C. Comstock, who examined the available and sufficiently reliable determinations of latitudes at several observatories, and concluded that they give some support to the hypothesis of a secular shifting of the axis of the earth. Thus, the latitude of Greenwich has pretty regularly decreased from 51° 28′ 38″.59 in 1826 to 51° 28′ 37″.95 in 1889. The Pulkova observations (especially reliable for this subject) show a decrease of latitude of 0″.33 during the years 1843 to 1882, which (taking into account the probable errors) corresponds to a shifting of nearly six inches every year (0″.005). Another quite independent Pulkova series gives much the same result. Konigsberg moves away from the Pole by 0″.003 every year, while Washburn, in Wisconsin, approaches the Pole by 0″.043 in the twelve months. The four would well agree together if the Pole were shifting every year by over four feet (0″.044) along the meridian of 69° west of Greenwich. Several other observations (Cambridge, Prague, Potsdam) also speak in favor of a shifting of the Pole.

The whole question is so important that the Geodetical Association decided, at the end of 1890, to send an astronomical expedition to Honolulu (189° east of Berlin), in order to make there consecutive determinations of latitudes which might be compared with those of Pulkova and Berlin. The expedition began its observations in June last, and the measurements of the first three months, now fully computed, proved that the changes were entirely accordant in magnitude with the European ones, but, as foreseen, they were in the opposite direction. However, a new explanation has been proposed in the meantime by S. S. Chandler, namely, that the variation is merely periodical, and will be completed in fourteen months. Fourteen months hence the axis will return to its present position. But this explanation does not account for the above-mentioned secular variations, so that we must wait now for further observations. One thing is, however, certain: the axis of the earth is not so immutable as it was supposed to be, and it is possible that the study now being pursued by Mr. Lockyer of old Egyptian monuments, which used to be astronomical observatories as well, may give some indications as to the changes of latitude since that remote peried.

—*Nineteenth Century.*

THE STARS AND STRIPES.

DR. B. J. CIGRAND.

TO all true Americans, whether young or old, every subject that pertains to the history of our nation is fraught with the deepest interest; and what item can be more instructive and patriotic than the evolution of our starry emblem, the standard of the leading nation of the world. No study can be more ennobling, none more thrilling than the story of our grand banner, beneath whose folds glorious victories have been gained, and heroic deeds had their immaculate birth. To the royal American every star and stripe that adorns our national ensign has a tongue. They speak to him of the struggles of our forefathers while grounding the foundation of grand government; they tell of the sufferings of the past, the glories of the present and untold triumphs of the future. The colonies up to the Revolution, in allegiance to the mother government, retained the standard of the old country, with the addition of some local emblem which was thereon inscribed as a distinctive feature. Massachusetts adopted the pine tree, and the other colonies followed the example and labeled their respective colonial flags with some similar appropriate device. A few, instead of blazoning the banner with some design, chose to inscribe some expressive sentiment,—*i.e.*, "*Liberty or Death!*" "*Come if you Dare!*" "*Liberty and Union;*" "*No Oppression;*" and scores of others of like expression. In the fall of 1775, the Colonial Congress, then in session at Philadelphia, appointed Messrs. Franklin, Lynch and Harrison, as a committee to consider, and recommend a design for a Colonial Flag. General Washington was then in camp, at Cambridge, Mass., and the committee went there to consult with him concerning the work in hand. After several days of barren consultation, this resolution was finally agreed upon:

"RESOLVED: That the colonial flag shall consist of the British Union with thirteen stripes alternate red and white."

This met with approval, and shortly before midnight the committee adjourned. The British Union was accepted, to show that the Colonists meant to remain royal if the mother's treatment would become less harsh; but in the event she failed to recant, and give justice, the thirteen stripes would stand out boldly to suggest that the colonists were united, and would by the aid of sword and pen demand representative rights. This latent language of the New Design was known to the colonists only. On the thirteenth of December 1775, Gen. Geo. Washington himself hoisted to the top of a liberty-pole at Cambridge, the ensign of the maturing Confederacy. The British soldiers who were stationed in Boston seeing the new banner interpreted it on account of the Union to mean subjection, and immediately fired a volley of thirteen shots thus recognizing by accident, the American flag. But we find that the fair salute was not so fraternally intended, the British learning of their ridiculous mistake, began to initiate new and daring outrages on the people of Boston and vicinity; the Mother Country too assisted in adding additional unpleasantness, and the American spirit broke forth in the Declaration of Independence. After July 4th, 1776, the colonists no longer would tolerate the British Union on the banner, and congress appointed a committee to draught an American flag; in short notice the committee had given birth to a standard the like of which the world had never before seen, both as to appearance and meaning. Congress on June 14, 1777, accepted the committee's work and the following resolution passed:

"RESOLVED: That the flag of the thirteen United States be thirteen stripes alternate red and white; and that the Union be thirteen stars, white, in a blue field, representing a new constellation."

The flag of the army was made early in June by Mrs. Col. Ross, of Philadelphia, and the design from which she produced it was drawn by Gen. Washington; she improved on the idea of the star which she gave but five points instead of six, as the General had it. The flag was first hoisted by Paul Jones of the *Ranger* to the command of which he was appointed the same day the flag resolution passed.

After the war closed when new states were added to the Union of States, it was decided to add a star for each such new state, the addition to be made the 4th of July following. Hundreds of patriotic songs have been written on our starry ensign but the favorite one contains the following truthful lines:

Oh! Columbia the gem of the ocean,
The home of the brave and the free,
The shrine of each patriot's devotion,
A world offers homage to thee.

Thy mandates make heroes assemble,
When Liberty's form stands in view;
Thy banners make tyranny tremble,
When borne by the red, white and blue.

THE TEACHER.

ARITHMETIC. XI.

H. B. Brown.

IN a former article on Arithmetic attention was called to the subject of proportion as proportion without giving any special reasons for the work. In this, the attempt will be to show why proportion is true. Not that it shall be proven geometrically, but shown arithmetically.

Let another problem be taken. Thus, If 40 men, in 30 da. of 6 hr. each build a wall 300 ft. long; in how many days of 8 hr. each can 50 men build a wall 350 ft. long?

Solution by proportion :

50 : 40 : : 30 da.
8 : 6
300 : 350

Write 30 da. for the 3rd term because it is of the same kind as is required in the answer.

If 40 men require 30 da., 50 men will require fewer days, therefore write the lesser number for the 2nd term and the greater for the 1st. If 6 hr. per da. require 30 da., 8 hr. per da. will require fewer days, therefore write the lesser number for the 2nd term and the greater for the first.

If 300 ft. long require 30 da., 350 ft. long will require a greater number of days, therefore write the greater number for the 2nd term and the lesser for the first. Employing cancellation, multiplying the 3rd term by the remaining factors in the second term, and dividing the result by the product of the remaining factors in the 1st term, the result is 21 days.

∴ If 40 men, in 30 da. of 8 hr. each build a wall 300 ft. long, 50 men, in 21 da. of 8 hr. each will build a wall 350 ft. long.

The student must constantly keep in mind that this statement is made up of simple proportions, and that when he is dealing with one of them, all the rest are supposed to be the same. For instance when he is dealing with the men, the number of hours per day, and the length of the wall are supposed to be the same in each part. The same is true of the other statement.

The problem is now solved by proportion. The statement given, or the reasoning, is abstract. Let us now see why in one case the lesser number is made the multiplier and the greater the divisor (For the 2nd term is the multiplier and the 1st term the divisor.), or in another instance the greater number is made the multiplier and the lesser the divisor.

Take the same problem. Make the statement of the known and the unknown parts the same. Thus:

Known part, 40 men, 30 da., 6 hr., a wall 300 ft. long.

Unknown part, 50 men, X da., 8 hr., a wall 350 ft. long.

Statement:

$$\frac{30 \text{ da.} \times 40 \times 6 \times 350}{50 \times 8 \times 300} = 21 \text{ da.}$$

Write 30 da. for the base term, because it is of the same kind as is required in the answer.

If 40 men require 30 da., 1 man will require a greater number of days. Therefore multiply by 40; and 50 men will require fewer da., therefore divide by 50.

If 6 hr. require 30 da., 1 hr. will require a greater number of da. Therefore multiply by 6; and 8 hr. will require fewer da., therefore divide by 8.

If a wall 300 ft. long require 30 da., a wall 1 ft. long will require fewer days, therefore divide by 300; and a wall 350 ft. long will require a greater number of days, therefore multiply by 350.

Employing cancellation, the result is 21 da.

∴ ———

In the above, it is clearly shown why 40 is placed in the multiplier and 50 in the divisor, or why 6 is placed in the multiplier and 8 in the divisor, or why 300 is placed in the divisor and 350 in the multiplier.

Of course when the statement is made, "If 40 men require 30 da., 1 man will require more, it is understood to be but a short way of saying "If 40 men require 30 da., 1 man will require 40 times as many to do the same work, therefore multiply by 40." And when it is said, "50 men will require fewer days" it is but a short way of saying, "and 50 men will require one-fiftieth as many days as 1 man, therefore divide by 50." The same is true with the rest.

When the student is thus able to analyze the problem, the teacher may be satisfied that the work is understood, and until this can be done, there is no absolute certainty.

The teacher should keep analyses before the pupil until he reasons on everything. Then will every other subject be reasoned out. The lack of this power to reason is seen in every subject and especially in grammar.

The student learns definitions and answers to questions without ever stopping to ask "why?"

The impression is usually given that of course the author knew just what he was doing. An author is human and as liable to err as any one. Hence we feel like impressing upon each teacher the importance of teaching the child the importance of knowing the *why* in every instance.

LANGUAGE LESSONS. I.

W. H. BANTA.

THE object in giving language lessons is to teach the pupil readiness and accuracy in the use of his "mother tongue." The work begins in his earlier talks with his teacher and continues to the end of his school course; but the formal language lesson, as separate from the reading or spelling work, when it shall take rank on the program as a regular exercise, should perhaps best begin when the pupil is able to read well in the Third Reader, or at about the middle of the *third year* work. The spoken and written forms should be taught together. He should be able to talk a good letter as well as write one.

This special language teaching will have to do with letter-writing in all its practical phases, letters to friends, business correspondence, &c.

He should be so taught that he could without difficulty write a brief account of any ordinary occurrence in such form and style that it would do to print in the local news-paper, without change of diction, capitalization, or punctuation.

Now the question very naturally arises, "How can this be done?" It is a very easy matter to theorize on the subject, but what should be the nature of the lesson given and what plan or method would you use?

Dear Teacher, I thus anticipate your questions, because I am to try in a series of short papers to answer them in a practical way.

The first lessons would consist in requiring the pupil to make brief statements about familiar things, as boys, horses, cows, cats, dogs, etc. The statements would likely be something like the following:—Boys run, Horses trot, Dogs bark, Cows give milk. Select certain ones from those given and require them to be written in the blank book for that purpose. They should be written with ink and in proper order and neatness. (If, however, slates are used, or blank paper for lead pencils, the first efforts need not be written in the language books.)

In the conversation about these statements the term "sentence" should be explained and defined. When the words of the definition are fully determined it should be mastered by each pupil. The definition must be fully tested by trying it with the sentences written and other groups suggested by teacher and pupils. The free use of the black-board by the teacher will prove very helpful.

Now examine the work done and give rules for the use of capitals and periods.

Test again by dictating sentences to be written and punctuated.

Dictate sentences to be written, as follows:

Write five sentences about things you saw on your way to school.

These sentences are examined by the teacher, the errors noted and made matter of conversation, after which the pupil will make corrections.

This work should be continued for several days, after which brief descriptions should be required. Descriptions of pictures or of objects. The school-room, the play-ground, the grove, the dog, the cat, the horse, etc., suggest the kind of subjects to be used for these descriptions. Follow each lesson in description with sentence writing.

Give list of subjects about as follows:

Write a sentence about the storm, the home, the city, the wind, the stars, the clouds. From these sentences, or others selected from those written, teach the Subject and Predicate.

Take for instance, "Mary is writing." About whom is something said in this sentence? Follow with the same question regarding eight or ten other sentences. Now the part of a sentence that tells what person or thing is spoken of is called the subject. Which of these words are subjects? Why? What is said about Mary in the sentence? Ask similar questions about each of the other sentences, after which the simplest possible definition of a predicate may be given, and the tests made as before. Long lists of subjects should now be furnished and the pupil required to supply predicates, and vice versa.

After a few days of sentence work some three or four lessons in description should be given, and each of these should be followed by the work of pointing out subjects and predicates of the sentences used. Careful attention must be given to capitals and periods.

The following simple rules for the use of capitals ought now to be given.

1. The names of persons and places should begin with capitals; as, John, Chicago, Henry, Manchester.

2. The words I and O should always be capitals.

3. The names of the months, and days of the week should begin with capitals. The names of the seasons should begin with small letters; as, Monday, June, spring.

4. Titles used with the names of persons should begin with capitals; as, General U. S. Grant, Mr. John Smith.

A great deal of practice in the application of these rules must be given by dictating sentences containing proper names. Also use sentences leaving blanks to be filled with proper names.

Ask a long series of questions about places and things and have the answers make complete statements.

The next step should be a lesson in common abbreviations and how to write and use them. This work should be tested by dictation exercises and answers to questions as before. Lists of abbreviations should now be made by the pupils to show the amount of work done and for convenience in reviewing.

I think that at this stage in the work special exercises in pronunciation should be given. The first drills should be on the sounds of a, beginning with ā. A list of twenty such words as āte nātion vāry chānge etc., and this followed in the course of a few days with a similar list for each of the following sounds, ă, â, ȧ, ä, a̤.

This work should continue throughout the entire language course.

WHAT SHALL WE READ IN THE PRIMARY CLASS?

W. C. Belman.

PERHAPS there is no other subject of the school-room work that has been discussed so much as primary reading, and perhaps there is no subject that is so poorly taught as regards its subject matter as primary reading, and again probably the purpose of this subject is less thought of than any other in the course.

The writer in attempting to present these thoughts does not claim for them originality but gives them as he sees them worked out in actual practice in the primary grade.

Let us ask the question, what are we here for and what is expected of us as primary teachers in reading? Is it to tell the child the words and have them told back and repeated again and again until he has learned them, then to take up a few more, day by day, and then apply the reader and have the sentences called off? Is it to have the child read a sentence just so because we read that way, and to have every child in the grade read it just so? It looks well, it sounds nicely when visitors are present, but is it reading? Have we, when the child can read every page in his First Reader, just so, done our duty? I answer, no! No teacher should attempt to teach primary reading until she has a higher ideal of what is before her and what possibilities lie awaiting development.

In the first place, the material in our readers is not that which should be placed before the child. Think of it fellow teachers, narrowing the minds of class after class by the same senseless material found in the most of our charts and First Readers, just as if each child was to be made to fit a certain piece of machinery, and all of his individuality, his spirit of freedom,—that which he has had ever since his birth,—must be turned and twisted with forty other children all to fit those lessons that they may read *the book*. For shame! Any teacher who has the spirit of childhood can prepare better work, material that will be more in harmony with the thought of the class. A live teacher will be alert to know that which will interest and hold the children most; and that, whatever it may be, will furnish food for the children to devour during the reading lesson. We are here, then, in the primary reading class, to lead the child to interpret the thoughts of others, and to enjoy what others have left for him to enjoy. If we expect to train our children in after life to love the great and beautiful thoughts of others, we must begin young, and no child who can speak or understand the language of his parents is too young to have presented properly the beauties of our literature.

It is our duty to present to him in child-like simplicity the stories that all children love to hear. It is not necessary to preach a sermon on morals when a point of ethics is involved, it is not necessary that every word should be analyzed and its full meaning brought out; but let the child absorb what he may, and we look for the results in his life, not to-day, but may be not until he is a man. We are here as teachers to form souls and we ought not to try to form them in an hour or a term. They grow for a life time, and, if the result of our teaching is visible in after years, it is just as profitable to the world as if we had obtained results now. No! Do not think of results now, but of life's results. But, says the teacher who has been following the reader, what shall I use as reading lessons?

Let me tell you some of the work I have seen used in the first year's class during the past year. At the beginning of the year, stories or sentences about fruits, pebbles, shells, flowers, some insects of different kinds brought in by pupils and conversed about so as to form an oral vocabulary concerning them, these simple forms of sentences about things which to the children were intensely interesting, were used until the children had unconsciously learned a large number of written words which go to make up our sentences. The teacher had carefully woven into these stories words that were common to many sentences, thus forming a basis for future work. Then followed, not necessarily in the following order, stories about Cinderella, The Wind, from Hiawatha, stories of the Eskimo, the story of Zumetta, Faleen, and others taken from "Seven Little Sisters" and simplified, the story of Hiawatha's childhood, his friends, the birds and beasts, and flowers, the rainbow, with all the interest which would center in the wigwam, and river, and pine trees, and firefly; there were also introduced stories from the myths of Greece, the story of Eolus, Porserpina, and a few others. A pretty little poem about the new moon caused intense interest in its phenomena. All these stories were worked out with the class and each gave them new power in interpreting printed or written thought. Were they taught reading? I answer by saying they can read nearly anything in the First Reader, much of which they have not seen. Have they received any other benefit? I answer who can think of the relation of Hiawatha and the animals and not be morally better? Who can hear the stories of mythology and not be somewhat awakened to the great field of History? Who can become interested in the new moon and not hold a higher though immature idea of space and his Creator? Who can study the river and pine trees of Hiawatha and not know something of Geography? Who can read the story of Cinderella and not grow up less selfish? Who can gather shells and pebbles, and insects and other nature products and not be awakened to the great fact that nature is wonderful? Having done all these as a basis for and in connection with reading, can we not await patiently for results? It has not been our purpose at the present time to say *how* the child shall be led to interpret printed thought, we may speak of that in the future, but it has been our purpose to stimulate the teacher to make use of live material so easily adapted to child mind, and by its use, lead the child one step along the pathway toward a love for the good and beautiful in literature.

SCHOOL EXPOSITIONS.

MANTIE E. BALDWIN.

SCHOOL Expositions are not new. But a few suggestions will here be offered concerning the exposition that may be given in any school, with very little effort and with little time taken from regular school duties.

Once a month, or once in three months, an exposition might be advantageously held. It would serve as a stimulus to the pupils. An exposition, commonly, is an exhibit of the best products, manufacturers, work, &c, of a country. A school exposition, then, should be an exhibit of the best efforts of the pupils and of the results of those efforts. Let it be understood at the beginning of a school term that such an exhibit is to be made at some time during the term, say on some Saturday afternoon. The *best* work of *all* the pupils should be shown; not the best work of the best pupils, as is commonly done. The slowest, the dullest, the laziest, the most timid, will all have an equal chance, in this plan.

All kinds of work should be exhibited. Nothing should be prepared specially for the occasion. During the month or term, when a pupil solves a problem particularly well, make a note of it. Have that solution neatly written and put away. Or when a problem is clearly and well explained, have that problem put upon the board and explained on exposition day. In each grade of arithmetic do this.

When a pupil reads a paragraph or extract with especial intelligence and expression, note that and call for it on exposition day. Or when a class becomes interested unusually in a reading lesson, and all read with animation and enthusiasm, remember it, and have that lesson read at the exposition.

A spelling lesson that has been well written, or, if difficult and well spelled, should be brought up.

Specimens of the best penmanship of each child should be shown. Pupils should also write some upon the board.

Maps that are well drawn should be exhibited. Map-work should also be done that day on the board. Geographical reports of cities, states, or countries, reports that have from time to time been given in the geography classes, should be read again at the exposition. Maps of states should be drawn on the board and oral reports of location, products, industries, capital, &c, of each state, should be given by the pupils who drew the maps. Imaginary journeys should be traced upon the wall maps belonging to the school. In these the climate, productions, and occupations of the people in the states and cities visited on the journey should be described by the pupil who imagines he is taking the journey.

An interesting object lesson could be reproduced. Or a story in which the children were greatly interested, could be re-told at this time by them.

Essays and letters of merit could be re-read. In short, whatever has been of merit in each child's work during the month or term should be given again on exposition day. All written work should be tacked up on the wall. Neat problems, spelling lessons, reports, essays, letters, &c, should be where visitors could inspect them.

It will not be wise to tell the pupils beforehand what it is to be brought up. The teacher should make a note privately of whatever seems to be *each child's best* in each study, and on exposition day have that presented. Of course it will be necessary to make a programme of the order of presentation of work, so that the exercises may not be unduly protracted, and yet so each pupil's work may have a fair showing.

On Saturday forenoon, have the pupils assemble for an hour. At that time tell them what will be expected of each one. Have them assist in tacking up maps, papers, &c, selected by the teacher from their work.

Then at the usual school hour in the afternoon, have them come. Their parents and other friends are, of course, to be invited. Each child should be taught how to write a neat little note of invitation to his parents and other friends. These notes should be delivered one week before the day appointed for the exposition in order to give the friends time to arrange their work so as to be present. Saturday afternoon is usually a good time, for it is a sort of half-holiday with farmers and their families, and often with town people.

The children should be clean, neat, and tidy, but not dressed in their best clothes. These expositions are not for the display of fine dressing on the part of either teacher or pupils. Encourage each child to try to appear as a little gentleman or lady should, neat and clean and well-behaved.

The children and teacher should devote the first fifteen minutes of the afternoon to receiving their guests with courtesy and seating them comfortably. Then the exercises should be promptly given, after which a few minutes should be spent in inspecting the written work.

The teacher should explain wherever explanations are necessary to a proper understanding of any exercise or work presented. Some of the songs the children most enjoy might be interspersed through the other exercises to give variety. If the pupils have learned any gymnastic exercises, those could also be given. No declamations, or dialogues, or addresses, or essays for the occasion should be given, because this is intended to be not a school exhibition, but an exhibit of *school work.*

CIVIL GOVERNMENT.

E. McCulley.

ONE of the branches most neglected, and yet easily made the most interesting in the public school, is Civil Government. In fact it is not yet among the public school branches in many states. Many ignorant persons think it means the study of politics and that their children may become biassed in favor of some "strange Faith."

Let the young teacher study the subject until he becomes enthusiastic over it and can be independent of the petty text-books usually used. Let the class read their book's preface. See that they have a clear conception of the work before them. Briefly review the chief historical events of this land preceding the adoption of the constitution. Teach the three-fold nature of the instrument and see that each member of the class gets *some* idea of those divisions. Give a little memory work. They will easily remember the number of Articles, the number of Sections in each article, and the number of Clauses in each section. Testing their memory of these will make a delightful recitation. Next, ask for the subject of each Art. and Section. Don't go down to Clauses yet. The average teacher, who has not tried it, has no idea how easy it is for the ordinary pupil to answer such a question as —"Of what does Sect. 3, Art. 1, treat? Whenever they tire, introduce variations. Discuss with the class some particular clauses. When it is learned that $5,000 per year is a congressman's salary, have the class figure out how much that is per month, per day, and per hour, on the eight-hour basis. Compare a salary of two years with the value of some of the best farms in the neighborhood; also recount the expense, necessary and unnecessary, that cuts down the congressman's income. Perhaps some of the class have been to Washington and can testify as to the rate of the expense there.

When you take up the subject of election have the class hold a mock election, ballots, box, judges, clerk and all. Carefully follow the course of the returns from the precincts to their final destination. Announce your intention beforehand and have the class question their fathers whereby more information and interest may be gained. Recently the writer met an experienced teacher who persistently declared that in presidential elections, voters voted for only one district elector and two electors at large in each state. That gentleman had not *read* his own ballot when voting.

But do not weary your class to death with the "practical" alone. It is all right if the doses are not too large and given too frequently. Do not ask for the exact words of the constitution. The meaning is what you are after.

Finally, go back to memory work frequently and ask for the *substance* of individual Clauses by number. By the time they have skipped around the whole instrument a few times some of the class can repeat the text substantially from beginning to end, something you have not required.

It may be urged that this is of no educational value. Young teachers must not give heed to such. Cranks have so talked against memory work in this country as to nearly ruin all scholarship. Memory itself is a strong element of education. No good teacher objects to memory work if coupled with well-digested facts.

NATURE, THE SOVERIGN SCHOOL MISTRESS.

W. H. Venable, LL. D.

HE who co-operates with nature, in the work of educating the young, will discover that nature's text-book is illuminated on every page with the inspiring word, "Freedom." Freedom is the best good. Freedom is good for the body; good for the soul; good for man—for each organ and part of him. even to the minutest atom that enters into his composition, and for every motion of life or spirit that stirs his being. Freedom is strength, activity, life—unfreedom is feebleness, paralysis, death. Freedom is neither license nor constraint, neither stimulation nor stupefaction, nor the condition of the overnourished hot-house plant, nor of the neglected weed by the barren way-side, nor of the rank, untended wild vine of the forest, but it is the state of the cultivated vegetation of the fertile, sunny, garden bed. Freedom is the condition which allows man to become his perfect self in the happiest way. It is favorable opportunity to conform to the law of individuality, to adjust man's faculties to their natural and proper use, to seek and find one's own physical and spiritual heritage, and to reach the full station of independent manhood. Freedom is not the right to do as you please —it is the liberty to do and become what you are capable of in the legitimate exercise of your own powers; the privilege of obeying the external commandments inscribed by the Creator upon your members and your mind.

There can be no true obedience without freedom. To obey the laws of health I must be permitted to obtain proper food, practice suitable exercise, breath pure air and sleep in peace. The mind's health, also, requires wholesome surroundings and opportunity to enjoy them. Elegantly has Holmes elaborated an old familiar figure illustrating my subject. "Look at the flower of the morning-glory the evening before the dawn which is to see it unfold. The delicate petals are twisted into a spiral which, at the appointed hour, when the sunlight touches the hidden springs of its life, will uncoil itself and let the daylight into the chambers of its virgin heart. But the spiral must unwind by its own law, and the hand that shall try to hasten the process will only spoil the blossom that would have expanded in symmetrical beauty under the rosy fingers of the morning."

Not only must the plant blossom in its own way—it must remain of its own species. Shall one say in obstinate pride or blind conceit: "I will make of this plant what I please, I will conform it to my ideal—it shall bear peaches—it shall bloom roses — it shall ripen corn, it shall grow like Jack's bean, a hundred miles high; it shall be a creeping moss." Or shall we reflect, with humility, as co-workers with God: "What will come of this marvelous perennial that I am permitted to train? What lovely and heretofore unheard-of blossom may it unfold? How can I best nurture and protect its tender leaves? How can I discover what soil, situation and culture are best adapted to it?"

Fellow teachers, let us emancipate ourselves from the slavery of a mechanical system which ignores nature, forgets God, and reduces us to tasked operatives, supervising a spinning jenny. Let us emancipate the children from the tread-mill task of grinding out lessons for the sake of recording the grists. Lead them back to the freedom of Nature, make them conscious of mind, thought, affection, duty and joy. Feed them not on husks, but call them to the fruity orchard of vital knowledge and to the flowing waters of living virtue. Measure your success not by the number of subjects taught, but by the number of minds roused to action. Count it no merit to have passed your class with an average per cent. of 99, unless you can claim also that the class has learned to love learning. Show me one boy or one girl whom you have induced to seek study as a pleasure rather than a task, and I will say you deserve the crown of praise. Make of this boy an original man, make of this girl a woman whose mind to her shall a kingdom be, and no crown of praise can add glory to your brow.

Oh, that some blessed revival could come upon the brain and heart of our profession; could fall like sunlight from heaven and illuminate and warm us for our duty. For we forget the principal things we should remember. We lapse to unconsciousness of our greatest privilege. The teacher should more than teach, more than govern, more than love; he should inspire his school. Inspire, breath into the pupil the animative principles, the soul-breath, the awakening spirit that gives consciousness of the need of activity, power, culture and education.

SOME LESSONS IN DRAWING. XII.

(*Conical Objects.*)

G. W. FERGUSON.

WE will first consider the application of the frustum, given in our last lesson. A tub, bucket, tin pan, and tumbler are frustums of cones.

The figures in the first cut indicate the steps taken in drawing a frustum resting on one of its sides.

1. Draw the longer axis of the visible ellipse.

2. Line of symmetry and produce it.

3. Visible ellipse.

4. Set off depth of model, distance from top to bottom.

5. Get slope of lower line, produce it until it cuts the line of symmetry, and from thence draw line 6 tangent to the ellipse.

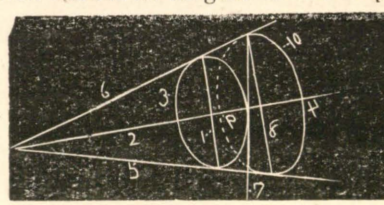
6. Imagine a vertical line dropped from the highest point in the elliptical base. If you cannot imagine a line you should make a plumb of your pencil by hanging it loosely by the lead between the thumb and forefinger, the edge of the pencil corresponding with the vertical line. Now close one eye, sight past the pencil until you can just see the highest point in the base. Where does this line appear to cut the model?

Supposing that it would touch the extreme right of the visible ellipse, erect a vertical line directly over the corresponding point in our drawing and produce it until it cuts line 6. Thus we will have found the highest point of the base in our drawing. It is also the upper end of the longer axis of the base and as we have learned that this is parallel to the longer axis of the other ellipse, we proceed to draw line 8 parallel to line 1. This should be produced until it cuts line 5 and the longer axis of the base will have been drawn.

This line may be found in another way: Imagining a line connecting the highest with the lowest point in the end that is turned from us, then the question, how much of the model is cut off by such a line? This line of course is always at right angles to the line of symmetry and parallel to the axis of the other end of the frustum.

Set off the corresponding distance on the line of symmetry, and draw a line through the last point found and produce it until it cuts the upper and lower lines.

Now as we know that the longer axis divides the ellipse into two equal parts, we proceed to set off point 9 as far to the right as 4 is to the left of line 8. This being done we have located the ends of the shorter axis. Draw line 10 or the ellipse of the base complete, as this is the only true way of making the proper connection with the side lines, which should be tangent to the ellipse.



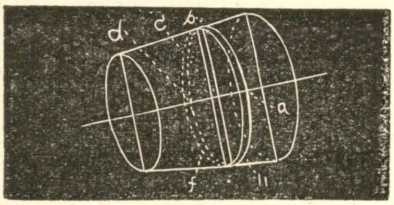
Supposing the frustum to be a wooded bucket, the first point I would call your attention to would be the fact that the hoops are in reality parallel to the top and bottom of the bucket, and of course the ellipses are parallel; but in appearance they are the boundaries of planes which appear to vanish in a distant line or trace, the same as parallel receding lines appear to vanish in a distant point, and consequently they do not appear parallel to each other but the farther edges appear closer than the nearer edges because the visual angles would be smaller than those formed by the nearer edges.

Supposing that we have the frustum with its two ellipses drawn complete and that the upper hoop appears to be one third of the way from the top to the bottom of the bucket, these measurements must be taken on the line of symmetry.

Trisect the line of symmetry between the top and bottom of the bucket on the front and back sides. The points of trisection ab on the front and back sides are the ends of the shorter axis of the ellipse that is to represent one edge of the hoop.

Trisect the shorter axis or line between ab and through c, the point of trisection, draw the longer axis d and produce it until it cuts the side lines 5, 6. Draw the ellipse 11.

If the width of the hoop is equal to one-eighth, sixth, or fourth, or whatever part it may be of the distance between 11 and 3 we set off the required distance to right or left of 11 as the case may be and divide up the corresponding space on back of bucket in the same manner, also the line between 1 and 8 and through the last point found draw line e parallel to 1 and 8 until it cuts 5 and 6 thus forming the longer axis of the ellipse forming the other edge of the hoop. Draw ellipse f and one hoop will have been completed.



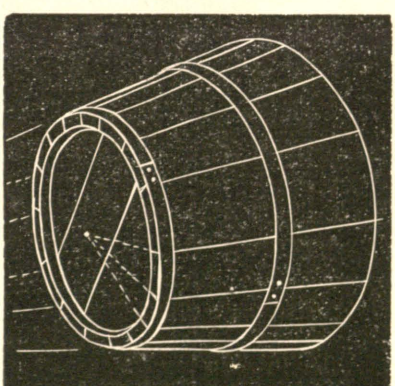
Is it necessary to go through all this in order to draw a bucket? No, not after we once know how it really should be and we have drawn it several times. Unless we faithfully work this out and thoroughly understand the principles thus involved, no matter how much labor is required at first, we cannot hope to work intelligently. In this way we avoid the too frequent blunders of making our drawings look flattened instead of round, the invisible end being drawn lense-shaped instead of elliptical. The hoops appear to go only half way round. Not enough curvature at the top and bottom. You notice that the hoop appears to grow narrower as it recedes round the bucket.

The next point is how to represent the bottom of the bucket as the staves project below it. Only a moment's study and we find that it is similar to tracing a hoop round the bucket, as it is only tracing a similar figure round the inside of the staves.

Besides that just mentioned we have another figure, the thickness of the lower ends of the staves.

In the first instance we have represented two parallel ellipses running round the bucket and the distance between them or the width of the hoop being turned towards us, in the second the distance between the ellipses, or the thickness of the staves, forms a receding plane, the width of which, in appearance, is the greatest at the ends of the longer axis, because it is not foreshortened as at the ends of the shorter axis.

The staves appear widest at the point nearest to the eye and become narrower as they recede or approach the edge of the bucket because they become more and more foreshortened.



The staves form a part of the cone and hence the lines must be drawn towards the apex.

We need only to produce the side lines of the bucket until they cut each other and run all the lines in the staves towards this point.

To locate the apex of the cone when the bucket is turned to or from us so that the side lines are not, seemingly visible, we should, after drawing the ellipses, get the slope of the edges of two staves that are on opposite sides of the bucket and produce them until they cut each other and run all the staves toward this point. The short straight lines between the ends of the staves should be drawn toward the perspective center of the ellipse; this is always beyond the true center of the ellipse.

THEORY OF TIDAL WAVES.

ALLAN R. THORNE.

THAT oceanic tides were in some way due to the influence of sun and moon was known long before Newton solved the mystery by his discovery of universal gravitation. He saw at once why the waters of the ocean rose beneath these heavenly bodies. He knew that in the depths of the sea the water must be compressed by the great weight of water above; that this weight is due to the earth's attraction alone; and were that attraction weakened, whether actually or in effect, the water must expand until the forces of gravitation and expansion came once more into a state of equilibrium. In the attraction of those distant bodies, the sun and moon, he found the cause he sought. The two forces acting in opposite directions were in effect but a single force equal to their difference; and the water, thus having lost part of its weight, increased in volume by its own expansibility.

It is easy to understand why the water should be heaped up on that side of the earth nearest the moon; but there is a similar tide on the opposite side which is not so easily explained. Newton disposed of this question by supposing it due to the unequal attraction of the moon. Gravitation diminishes as the inverse square of the distance; the water upon the side nearest the moon is attracted most and rises, followed by the solid earth, which comes next in point of distance and attraction. The water on the opposite side of the earth, being farthest away and of course not so strongly attracted, is left behind.

Whether Newton understood it so or not, one gets the idea that the farthest side of the earth is at a fixed distance from the moon, and that the moon's attraction has stretched the earth out toward herself, much as one might stretch a piece of rubber.

Erroneous as this statement is, it has found a place in most of our common school text-books, probably because nothing better has been offered. Now and then an author ventures to suggest a different theory, perhaps the true theory, but fails to make himself clearly understood. Here is an example from excellent authority :

"The place of the earth's center is not changed, because the motion of the moon, in its path, keeps the distance between the two bodies the same. Hence, as the position of the centre is not disturbed, and the diameter of the earth has been prolonged, it follows, paradoxical as it may seem, that the attraction of the moon upon the mass of the earth has forced the opposite side farther from the center."

In the above paragraph not a single idea is offered in explanation of the phenomenon, and the student remains ignorant as before. He refers to other standard authorities with but little better success; nowhere can he find a satisfactory statement of the cause of tides.

Having myself experienced this difficulty, and at last gathered enough facts from various sources, I have put them

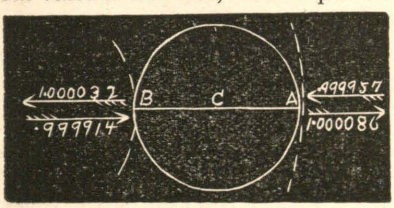


FIG. 1.

together in form of a mathematical demonstration of such simplicity that it is hoped all may understand.

The theory of the tide produced by the sun will first receive attention; for, though least important, it is most easily demonstrated.

The centrifugal force of the earth in its motion about the sun is exactly equal to the attractive force of the sun, and at any time is equal to the square of its velocity divided by twice the radius of its orbit. Choosing two points upon the earth's surface, one nearest the sun and the other opposite, we find that, since the time of revolution about the sun is the same for both, their respective velocities are in direct proportion to their distance from the sun.

To find the centrifugal force at A, (Fig. 1), square its velocity and divide by twice its distance. Representing the centrifugal force at C by unity, that at A is found to be .999957. By a similar process B is found to have a centrifugal force of 1.000032.

Since attraction varies inversely as the square of the distance, we find that at A to be 1.000086, while at B it is but .999914, taking the attraction at C as unity.

At A, then, nearest the sun, there is

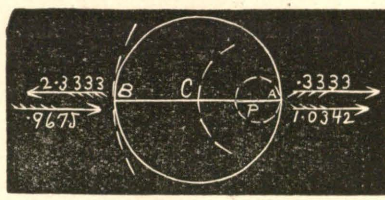


FIG. 2.

an attractive force of 1.000086 opposed by a centrifugal force of .999957, leaving a tide-producing power of .000129. At B, farthest from the sun, an attractive force of .999914 is opposed to a centrifugal force of 1.000032. Here is also a tide-producing power represented by .000118, somewhat less than at A,—a conclusion verified by the observed fact that the opposite tide is not so high as the direct.

The theory of the lunar tide is more complicated, for the earth becomes the central and attractive body; yet, strictly speaking, the moon does not revolve about the center of the earth, but both bodies revolve about a common center of gravity at a distance inversely proportional to their mass. As the earth's mass is eighty times that of the moon, this common center of revolution is but three thousand miles from the center of the earth, and consequently lies within the earth itself. About this center the earth revolves once in a lunar month, the centrifugal force of its motion about this point exactly balancing the centrifugal force of the moon in her orbit.

As the rotation of the earth upon its axis produces a centrifugal force at the equator, so will its revolution about any other point within itself produce a like force, varying with the distance from the center of revolution. Thus, at A, (Fig. 2), a particle describes a small circle about P. At C the circle is much larger; while at B it is largest, the distance BP being seven times AP.

As A, C, and B perform a revolution in the same time, their velocities are in proportion to their distance from P, or as 1, 3, and 7; and their centrifugal forces are as .5, 1.5, and 3.5. Representing this force at C by unity, the proportional parts become .3333, 1.0000, and 2.3333.

The proportional distances of the three points, from the moon, are 59, 60, and 61. As the moon's attraction varies according to the inverse square of these distances, we find the attraction at A represented by 1.0342, taking C as unity, while B is but .9675.

The two forces are exactly equal at C, the center of the earth, and we may compare our series of proportional parts:

Centrifugal,	2.3333	1.0000	.3333
Attractive,	.9675	1.0000	1.0342

At B the centrifugal force is 2.3333, the attraction, .9675; leaving a force of 1.3658 acting in a direction away from the earth and producing a tide there. At A the attraction is 1.0342, the centrifugal force, .3333. But here both forces act in the same direction, and their combined effect is 1.3675, indicating a tide somewhat larger than upon the opposite side. The conclusion is again in accordance with observed facts.

Half way between these two tide waves there is no tide, so our text books say; and more than this, we are taught to believe that, since the lines of attraction are slightly convergent, the moon itself draws the water toward the earth at that place.

Apparently true, nothing could be more misleading in fact. A particle at R, (Fig. 3), is in motion around P at a distance of nearly five thousand miles. Its centrifugal force, on the same scale as preceding computations, is 1.6667, and in the line PR prolonged. Now this may be conceived as the resultant of two forces; one directly from the

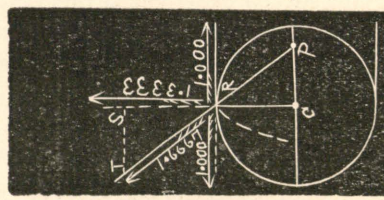


FIG. 3.

moon, the other at a right angle to this and directly away from the earth. Since RST and RCP are similar triangles we have,

RP : RT : : CP : ST

or, 5 : 1.6667 : : 3 : (1.0000)

and RP : RC : : RT : RS

or, 5 : 4 : : 1.6667 : (1.3333)

Centrifugal force from the moon is shown to be unity, and is just balanced by the moon's attraction at her mean distance of 60; while the centrifugal force from the earth is 1.3333 without an opposing force, except that due to convergence of the lines of attraction, already mentioned. The correction for this convergence reduces the tide producing power to 1.31 at the point R.

Thus mathematical demonstration shows that the moon produces a tide, not only beneath it and opposite, but entirely around the earth. The greatest is immediately beneath the moon, being represented in our ratios by 1.3675. Next is the opposite tide of

1.3658; while the smallest is 1.31, half way between the other two. As this latter tide, the lowest possible level of the ocean, becomes our standard of comparison, we may subtract its value from that of the others, leaving forces of .0575 and .0558 to produce the visible tides.

—*N. E. Journal of Education.*

A Lifelong Study.

The study of geography does not begin where some other study is finished; it is a part of the entire education of the young, it enters in some form into every grade of school life, and it is never finished even when graduation breaks the connection between the school and the student. It is *the* study that is never finished. Facts are learned of it every day, and its importance is unquestioned. It well becomes teachers to give such instruction in geography that the after life of the pupil, the life when books are rarely dipped into and technical works are wholly eschewed, may be full and ready to grasp all the facts that daily arrive in new form to arrest the attention.

Students of history are always impressed by the powerful influence which the physical features of nature exert in shaping the current of events. The existence of a lake or a mountain chain has at times produced most important historical results. When the Chinese, in the first century of our era, overran all Turkestan, it is said that their General Panchow, with his army, reached the Caspian sea, and that he was so impressed by the supposed difficulty of crossing it that he abandoned his design of extending his master's dominion into Europe. It has often been asserted that the great mountain barrier which incloses Italy on the north was absolutely essential to the growth and maintenance of the early Roman empire.

All that covers Egypt with fertile fields, hemmed in everywhere by sterile wastes, is the sediment which the Atbara river, the Nile's great tributary, brings from rich Kassala and the mountains of Abyssinia and spreads over the Nile valley. It has been maintained by Sir Samuel Baker that if the Sudanese only knew their power it would not be difficult to divert the Atbara from its channel and dry up its waters in the Nubian desert, turning Egypt into a barren wilderness like the surrounding waste. —*Journal of Education.*

PSYCHOLOGY—REASONING.

H. N. CARVER.

IN the last two articles of this series, various general matters and some of the most important terms have been explained. These have been chiefly what in Logic are called terms, and in Grammar nouns, in Psychology, concepts. The faculty has been called the science-making faculty; but, plainly, what we have been considering constitute only a very small part of the entire subject, they have been only the *disjecta* of our knowledge. We must now look, very imperfectly indeed, at the same things when taken connectedly, at terms when combined into propositions, and concepts when brought into proper relations in thought; and we must see how new propositions are obtained from old ones, how new truths are derived from old ones. This is the proper subject-matter of Logic, and the young teacher who finds this short article unsatisfactory, and it is hoped all of them will find it only suggestive, can do no better than to read the little Science Primer on Logic by the late Professor Jevons. That will lead on to the larger works; for the subject is an endless one, and has employed the keenest thoughts of the greatest minds.

Let us start with the proposition, "The horse is an animal." Here our consciousness, or knowledge, is a consciousness of an agreement, namely, between the two terms "horse" and "animal," or the two classes of things for which the terms stand, or the two concepts,—it is immaterial which way we look at it. Had I said, "the horse is not an animal," the consciousness, or knowledge, would have been of a disagreement. From this it will be seen, that a proposition is only an expression of the relations of agreement or disagreement between two terms, or concepts. It will be remembered, that two important properties of terms have been referred to already, their extension and their intension; the former referring to the number of sub-classes, or individual things, or to the percepts, included under it, and the latter to the number of attributes included in it. This gives rise to two most important methods of interpreting propositions, in respect of their extension or their intension. Thus, the proposition already given, interpreted extensively, means "the horse is one of the sub-classes of the term animal," or "one of the individual things included under the term animal"; intensively, "horse has all the attributes of animal." This is a matter of the greatest interest, and should be thought out until it is perfectly clear. A little work upon the article in the April STUDENT will make the subject perfectly plain.

At this point, another important matter must be explained, the distribution of terms. Any term of a proposition is said to be distributed, when it stands for *all* that the term implies, is taken in its full extent; it is said to be undistributed, when it stands for only *a part* of what the term implies, is taken not in its full extent. If I say, "all horses are animals," the subject is plainly distributed; but the predicate is undistributed, since it evidently refers not to all animals, but to some only. If I say, "no men are brutes," both subject and predicate are distributed, since each is taken in its full extent, the assertion is a disagreement between all men and all brutes. This distribution of the subject enables us to divide propositions into two important classes, universal propositions and particular. If the relation between the subject and the predicate is an agreement, the proposition is an affirmative one; if a disagreement, it is a negative one. This double division gives rise to the four leading kinds of propositions; two universals, an affirmative and a negative, and two particulars, an affirmative and a negative. It is customary to designate the universal affirmative by the letter A; the universal negative by E; the particular affirmative by I; and the particular negative by

O,—the A and E being the first vowels, and the I and O the second in the Latin verbs *affirmo,* I affirm, and *nego,* I deny. Now, using letters for our terms, we may represent the four kinds of propositions thus :—A=All M's are P's; E=No M's are P's; I= Some M's are P's; O=Some M's are not P's. Of course, in A and E the subjects are distributed; but it will be noticed that both affirmative propositions have undistributed predicates, and both negatives distributed predicates. It should be remarked that all equations and other propositions in which the copula is really the sign of equality, often called equipollent propositions, have both terms distributed. Proper nouns, too, are distributed. If I say A=B, I mean all A=all B. "Chloride of sodium is common salt," means "all chloride of sodium is all common salt." "Jefferson was the author of the Declaration," is of the same kind.

It is evident that from single propositions, like A, E, I, and O, new truths may be obtained. If I know that all M's are P's, I can infer that at least some P's are M's; if no M's are P's, evidently no P's are M's, etc., etc. This method of inference is known as conversion, and consists merely in changing the positions of the subject and the predicate. Again, if I know that A, all M's are P's, is true; I can infer that E, no M's are P's, is false, and O is true, and I is true. If I know that A is false, I do not know whether E is true or false, but I know that O is true, etc. This kind of inference is known as opposition. It is a very interesting subject and will well repay very careful attention, since we are liable to fall into mistakes from lack of care here. A somewhat notorious lecturer of the day undertakes to prove the existence of the Supreme Being in this way : he says there is a dependent and there must be an independent, that is, he infers the independent from the dependent. But when he says there is a dependent, he can mean only that some things are dependent, and when he says there is an independent, he can mean only that some things are not dependent. And this means, that he *infers* O from I, a thing which cannot by any possibility be done. The best discussion of this whole subject of immediate inferences, as it is often called, the young teacher will find in Archbishop Thomson's Laws of Thought.

Evidently, this way of comparing two things, or two terms, directly with each other, is not the only way we have of getting new knowledge, that is, of finding out whether things agree or disagree with each other. We can find out whether two things thousands of miles apart agree or disagree by simply comparing them with some third thing, a surveyor's chain, a yard stick, a pound weight, etc. That is, we have not only methods of immediate inference, but also methods of mediate inference, inference, that is, through a middle term, (mediate means middle.) If I say, all M's are P's, and all S's are M's; plainly, all S's are P's; that is, I have found out the agreement of S and P through M. Now, this method of getting new knowledge is usually called reasoning, and this special method, syllogistic reasoning; and the little specimen given above is called a syllogism. The subject is a vast one, and only the simplest parts can be referred to here. The last proposition is called the conclusion, and its predicate, P, is called the major term, because the predicate usually has a greater extension than the subject; and its subject, S, is called the minor term, for the reason just given. Of the other propositions, the one which contains the major term, no matter where it stands in the syllogism, is called the major premise, and the one which contains the minor term the minor premise. The term common to both premises is called the middle term, because through it the subject and the predicate of the new proposition are seen to agree or disagree.

The books give a number of rules to which the syllogism must conform, if the conclusion is to be legitmate. 1st. There must be three terms and no more, in other words, there must be but one middle term. If the major term and minor agree or disagree with two different things, we can not tell whether they agree with each other or not. 2nd. The middle term must not be ambiguous. This is really the first rule, since an ambiguous term is practically two terms. 3rd. The middle term must be distributed in at least one of the premises. If the major term agrees with only a part of the middle term, and the minor term also agrees with only a part, we cannot tell whether the parts are the same parts, and it is evidently impossible to say whether the major and minor agree or disagree. The rule is again really the first rule. 4th. At least one of the two premises must be a universal. If only part of the major term agrees with the middle, and only part of the minor with the middle ; plainly, we cannot tell whether any of the major and the minor agree or disagree. 5th. At least one of the premises must be an affirmative. If neither the major nor the minor term agrees with the the middle term, nothing can be told about their agreement or disagreement with each other. 6th. If either premise is negative, the conclusion must be negative. If one term agrees with the middle term, and the other disagrees, they must disagree with each other. 7th. No term must be distributed in the conclusion, if it was not distributed in its premise. If nothing is affirmed or denied of a part of either major or minor term in the premises, nothing can be either affirmed or denied of that same part in the conclusion. A violation of this rule is technically called an illicit process of the major or the minor term, according to which term has been used in violation of the rule. An illustration of its violation may be found in the quotation from Beecher in the examination questions on Reading in the June number of THE STUDENT.

Let us see one or two illustrations of the rules. If I say, all M is P, and all S is M, I may conclude that all S is P; no rule is violated. If I say, all P is M, and all S is M, I can say nothing at all about S and P, there is an undistributed middle, and rule 3 is violated. If I say, some M is P, and all S is M, I can draw no conclusion; the same rule is broken. If I say, all M is P, and no S is M, then, no S is P; I have an illicit process of the major term and have violated rule 7. But these must suffice for the illustration. One caution must be added before the subject is dismissed. When it is said that no conclusion can be drawn, the words must be taken literally. If I cannot say that S is P, I am not by any means entitled to say that S is not P, as a conclusion from the premises; though I might very much desire to say so, and as I probably would say, if I did not have a good degree of regard for the truth.

This article must be taken as only suggestive. There are a hundred things that ought to be said, but which have not been said; and what has been said, should have been made concrete by illustrations, which space and time have forbidden here. It is believed that what has been said is accurate, and embraces the fundamental matters that sooner or later must be learned in the shape here given by any one who would understand the subject-matter of grammar and rhetoric and so-called pedagogy.

ORATION AT THE DEDICATION OF NEW COLLEGE BUILDING. II.

GOV. IRA J. CHASE.

GARFIELD once said that a university might be established upon a log, with Mark Hopkins upon one end of it and a student on the other.

Agassiz on Penikese Island, before opening his school of science composed of professors from all parts of the country, said: "Let us ask the blessing of God upon our labor while we investigate the mysteries of creation." Then folding his hands and bowing his head, he poured out his soul to God, creating an impression so profound upon his hearers that it could never be forgotten by a single one who had been brought under the spell of one of the greatest of men.

With you, my friends, in whose success I have an abiding interest, there can be no life well or intelligently studied except in its relations to causes and results. Character is both a result and a cause. While you have been here whether one year or many your character has been solidified in part, at least, by coming in contact with fellow students; but in the main, by coming under the influence of your teachers. If you take from here a disposition of mind and heart independent of influences which are misleading, which shall at death find you prepared, it will be well. On any other ground, though you bestow your earnings in the interest of science or to feed the poor, and at last will your body to an indigent medical student for such purposes as he may elect, you will not be satisfied with your own life, for you have not brightened the gloom of the grave, dried a tear, or given rest to a weary traveler to the world beyond.

To accomplish the highest ends of life, the spirit of man must be prepared to live, that when the silent messenger comes he may be prepared to wrap the drapery of his couch about him that he may lie down to pleasant dreams. You are to become guides of undying spirits. How have you counted on the future? What have you resolved shall be the destiny of those brought under your influence? In an address delivered at Hiram College in 1876 by Jas. A. Garfield on "The life and character of Almeda A. Booth," which I wish you could all read, I make this quotation: "She accomplished in four years the ordinary work of ten, and did it perfectly. I venture to assert that in active powers of mind, in thoroughness and breadth of scholarship, in womanly sweetness of spirit, and in the quality of effective, unselfish work done, she has not been excelled by any American woman. I know of no man or woman who at 51 years of age had done more or better work. On my own behalf, I take this occasion to say that, for her generous and powerful aid so often and efficiently rendered, for quick and never failing sympathy, and for her intelligent, unselfish and unswerving friendship, I owe her a debt of gratitude and affection for the payment of which the longest term of life would have been too short."

This was the result of 15 years' association as classmate and fellow-teacher with this godly woman who, though born in poverty, acquired a fame and justly merited these words of praise from one of America's most honored and eminent sons. Though she has passed away, that focused light which she received from heaven is still casting its lovely rays across many a life that was darkness and doubt before it looked to her as a guide, when its pathway seemed hazy and uncertain. Well has it been said that nature and nurture have much to do with our lives.

Probably no woman ever dug down higher hills of difficulty or bridged broader chasms that seemed to separate her from the object of her desire, a consuming desire, to serve acceptably God and men.

In all human probability no child was ever born with more favorable surroundings than was John Quincy Adams. John Adams the Ajax of colonial times and his educated, cultured Christian wife were the peer of any.

John Quincy was under his mother's instruction until his tenth year when his father took him to Europe, where he spent two years in a training school in Paris while the father was engaged in the diplomatic service of his country. He was also a student at the university at Leyden, Holland, an institution of learning regarded by his father as the best in Europe. It is remembered that many happy hours were spent by him in the presence of Dr. Franklin and other eminent men of the world, who were his father's friends and companions. At fourteen he became private secretary of Frances Dana, Esq., who had been secretary of Legation under the elder Adams, but who had recently been appointed minister to Russia. Here young Adams remained fourteen months, performing his duties to the entire satisfaction of the minister. He was present when the treaty of peace was signed between the United States and Great Britain. He then attended school at The Hague for several months.

In 1775 he visited London, where his father had been appointed minister to the Court of St. James. This gave him opportunities to study the highest style of oratory from such living models as Pitt, Fox, Erskine, Burke and Sheridan. What splendid opportunities for a precocious boy of seventeen! He has been admitted to the presence of the grandees and nobles of the courts of Spain, France, Russia, Holland, and England. He longs to finish his studies from the same halls at Harvard, from which his father went forth years before. Permission is granted and he enters at eighteen and graduates in 1788. He then entered the office of that almost incomparable lawyer, Theophilus Parsons, who for so many years was Chief Justice of Massachusetts, and a writer on jurisprudence of commanding fame. At twenty-four young Adams was admitted to the bar. He said of the only four years in which he practiced his profession: "I had long and lingering anxiety in looking forward, doubtful even of my prospective substance, but acquiring more and more the means of it, till in the last of the four years the business of my profession yielded me an income more than equal to my expenditures."

At twenty-seven he was appointed minister to The Hague. During his stay here he was intrusted to negotiate treaties with Sweden and Prussia. "Through his long life," says his biographer, "Mr. Adams was himself a daily and devout reader of the Scriptures, and delighted in comparing and considering them in the various languages with which he was familiar hoping thereby to acquire a nicer and clearer appreciation of their meaning."

"The Bible was emphatically his counsel and monitor to his life, and the fruits of its guidance are seen in the unsullied character which he bore through the turbid water of political contention to his final earthly rest."

At thirty-four he was elected member of the senate of Massachusetts and occupied a chair in Harvard college; at thirty-six he was elected to the United States Senate; at forty-two Washington appointed him minister to Russia; at forty-eight, minister to the Court of St. James; at fifty, Secretary of State under Madison; at fifty-eight, President of the United States. Of his services in the House of Representatives until his eighty-first year, beneath the dome of the capitol, he exclaimed, "This is the last of earth; I am content."

To the names of Augustine, Xavier, Fenelon, Milton, Newton, Locke, Lavater, Howard, Chateaubriand, and their thousands of compeers in Christian faith among the world's wisest and noblest, it is not without pride that the American may add from among his countrymen those of such men as Washington, Patrick Henry, and John Quincy Adams. For a contrast to the distinguished statesmen whose character I have so briefly reviewed I would like to call the attention to Andrew Jackson, who was born in the same year. I prefer however, a stronger case than the illustrious chieftian and statesman who was a revolutionary soldier at thirteen and who carried a sword wound received from a British officer to his grave. Forty-two years after the birth of John Quincy Adams and Andrew Jackson in an obscure part of the country, of obscure parents a man child was born, who was destined to out-rival if possible, the glory and fame of the cultured Adams. From infancy to manhood it may be said, that not a day passed unfilled with anxiety and toil. He never enjoyed the advantages of school but for a single year, though in his manhood he was an untiring student by night and by day. His associates, from necessity, instead of being the cultured and refined, the educated and the rich, were for the most part vulgar and ignorant. At twenty-three he was elected a captain in the Black-Hawk war. The company soon mustered out and he inlisted as a private. The same year he was nominated for the legislature in Illinois, and received every vote from the community in which he lived but three. At the age of twenty-five or twenty-six he was elected to the legislature. At twenty-eight he was admitted to the bar. At twenty-nine and thirty-one served again in the legislature. At thirty-seven, elected to the Congress of the United States. He has acquired fame as a lawyer and debater. At fifty-one he was elected President. Before he was fifty-four he wrote the immortal Emancipation Proclamation, that gave liberty to over 4,000,000 slaves.

At fifty-six he was inaugurated for the

second time President of the United States, delivering the master-piece of all his state papers, his second inaugural address. Like Adams he was a devout believer in God. To a friend he once said, when asked if he was a Christian, "When my son died, the greatest sorrow of my life, I was not a Christian; but when I went to Gettysburg, and stood among the graves of our heroic dead, witnessing the great sacrifice that they had made in defence of their country's liberty, I then and there resolved to consecrate my life as a Christian."

It was during his journey to this National Cemetery Nov. 19th 1863, that he wrote upon his knees on a scrap of paper, that speech which at the time did not attract very much attention, but which since has become classic. This address was delivered before he was fifty-four years of age, and is regarded equal to any thing that ever came from the pen of the highly favored, educated, cultured Adams. In every sense of the word Abraham Lincoln, who died at fifty-six, equalled in statesmanship John Quincy Adams who died at 81. The father of Mr. Adams was perhaps, the peer of any man in the world; while the father of Abraham Lincoln was below the average in those qualities which make what the world calls success. Suppose the condition of these two boys had been changed. At your leisure work out the problem. No two lives in American history present a greater contrast, and yet they had many things in common. Both were patriots of the highest character; both had an insatiable desire for knowledge; to their credit be it said both improved their opportunities; both humbly trusted in Almighty God; both were honored by their countrymen, and both deserved the best that posterity can give to the grandest and the noblest of men. What gave these men power over themselves and mankind? I believe it was because they bowed before divine authority. They acknowledged the same teacher which Adam acknowledged. Had that teacher never spoken to Adam, Adam would never have spoken. Adam was not created in the weak and helpless state of infancy. The creation of the world was revealed to Adam by the great Creator, and by him handed to succeeding generations. Young ladies and gentlemen, will you be so cowardly in facing the problem of the future?

But permit me to draw another picture presenting another and quite different view of life but still illustrating my theme.

One of the greatest pieces of engineering skill is the Brooklyn bridge.

The Roeblings were made famous by building the suspension bridge at Niagara. In after years the elder Roebling concieved the scheme of building a suspended highway that would unite Brooklyn and New York. But before he could superintend the laying of a single stone he was so severely injured while inspecting the ground for the Brooklyn Pier, that he died. The responsibility of erecting piers and constructing a bridge fell upon the son, Col. W. A. Roebling. We are advised that the ancients held to a superstition that to insure safety to a bridge its abutments must be consecrated by the offering of blood from a human sacrifice. Be it so or not—though the superstition has passed away—the onward march of science claims, as is too well known, the sprinkling of blood at the hands of its most earnest devotees.

The Brooklyn structure,—that enduring monument to human skill, courage, and energy,—was not brought forth without claiming a frequent and costly sacrifice. What great enterprise ever was? The settlement and development of the New World passed unheeded for almost two centuries as compared to the march of empires in the Old. But as civilization flows westward, history uncovers the awful sufferings endured by the early settlers, before this land could become the Paradise of which we have become the heirs.

If we see, by the eye of faith, men and women amid the regions of a New England winter, kneeling on Plymouth Rock, weeping tears of joy and gratitude, while in thanksgiving they lift their voices to the God of compassion and love, for a land free from the tyrants, we also see the fearful surprises, planned by the red men, in which whole settlements went down by implements of torture and death. The blood of father, and mother, son and daughter consecrated the soil which has become our glorified inheritance.

The obstacles to national as well as individual success would be about infinite—if in the struggle for improvement women were less sacrificing, brave, and daring than men. Soon after the death of the elder Roebling, the son was stricken upon his bed from the effects of the terrible caisson desease, contracted while imperiling his life to save the caisson from destruction. He was carried from the scene of his labor to his sick room where he remained for eleven long years—rarely able all that time to leave his couch of pain. The cherished hopes of the father, inherited by the son, together with those of his own, seemed to be crushed. Must this mighty enterprise of the age suffer defeat at the moment of assured success? If not entirely defeated, must it suffer embarrassment for years for lack of scientific knowledge of the plans? Here are six assistant engineers each thoroughly skilled and trained for his profession; each noted for special talent for work assigned him. But this enterprise is so many-sided, so intricate, so gigantic, so great a departure from those of like character heretofore constructed, carrying with it the expenditure of fifteen and a half millions of dollars that neither of these, nor all of them, can be trusted. What can be done? How shall this obstacle to success be removed? The warmest personal friend of this prince of mathematics can not be admitted to his chamber. So delicate has become the nervous system that the voice of a stranger heard in a distant room can not be endured. What lever can remove the seemingly immovable obstacle? A missing link must be found, not a hypothetical, but a real, tangible one.

As is often the case, a woman supplies it. The foul gases of the caisson have poisoned the body but not the brain of our hero who is to direct from his sick chamber for eleven years what has been said to be "the rival of the greatest among the wonders of human skill." This great mind must be tapped and the genius of that fertile brain must flow into that of another and by that other communicated to one and all of his assistants. The spirit that accepts the tasks and performs the duties so gracefully, so successfully to the satisfaction, nay, admiration of the scientific world, is the same in kind as animated the brave and pure-hearted Joan of Arc when at the hand of a defeated and discouraged army she drove back in shame the enemies of France.

The same spirit that aroused itself from a sick couch at Long Branch, and stood for eighty days by the bedside of one who was more than a suffering king, with a devotion, often equalled, never exceeded, the spirit possessed by true and noble women. The most intricate problems within the range of applied mathematics are locked away. The key that is forged must turn easily in the brain of this helpless giant that the more wonderful than Alladin treasures may be brought forth from their hiding place to astonish the world, and prove a blessing more valuable than gold, to millions of his countrymen. The faithful wife who is the ever faithful nurse must be made to represent that curiously wrought and wonderfully delicate key. And under her husband's direction she takes her pen and pencil and masters the science of civil engineering, and applies it to bridge-building, draws a labyrinthine mass of lines and curves, comprehends the pressure of the air, strength of iron, the elasticity and tenacity of steel. During Troy's greatness and prosperity there was but one way into the proud city, and that was so devious that only a friend could trace the route. Our heroine mastered that which seemed the only way, intricate and difficult though it was, by which the caissons could be sunk into the depths, carrying with them the foundation stones of the piers 80 feet below tide water, then piling them tier upon tier in their colossal grandeur 276½ feet above it.

(*Concluded next month.*)

NOTES—SCIENTIFIC AND OTHERWISE.

The Whaleback.

A recent departure in ship-building is said to be as important as the invention of the steamboat itself.

It is a freight steamer made to ride through, and not over the, waves. It will excel the old style in many respects. The cost is less; a vessel of 3000 tons has a draught of only 17 feet, can be managed by a crew of 22 men, and uses 12 tons of coal per day, being $\frac{1}{25}$ as much as by the ordinary large ocean steamer.

The "Wetmore" is the name of the first "Whaleback" built on the Great Lakes and is the first of any description that has attempted to reach the waters of the Pacific. It has already successfully crossed the Atlantic.

The "Wetmore" is shaped like a cigar having both ends cut off to an equal diameter and is slightly flattened above to form a kind of deck.

A turret and cabin are all that appear on this deck.

This vessel left Duluth, where it was built, sailed to Montreal, took on a cargo of 90,000 bushels of wheat, and reached Liverpool in just 39 days.

It descended the rapids to Montreal but cannot return, the canals being too small.

Although encountering heavy seas on the Atlantic, so steadily did the vessel ride that the foot-prints of the grain heavers, and marks of the shovels were plainly visible in her cargo on arriving in England.

A passenger vessel of this style has

also been designed with 3 decks, supported above the cigar shaped hull on strong pillars far out of reach of the waves.

A movement is now under way to construct an entire fleet of "Whalebacks" for trans-Atlantic freight service.

They will be built in England and patterned after the "Wetmore".

The enterprise is to be backed by Northern Pacific capitalists.

The daily press has lately had much to say concerning the reported solution, by the Germans, of aerial navigation.

It is currently reported that aeronauts connected with the German army have devised a steering apparatus to which the huge balloons answer as readily as a ship obeys her helm. It is even reported that in one instance at least, a balloon sailed directly against a strong wind. If this is the case the motor must be exceedingly powerful and the balloon of great strength to resist atmospheric pressure. So great is the resistance that "supposing a balloon to move at the rate of forty miles an hour," says Harold Maxim, "there would be no necessity of a balloon, because, if only a small part of the material which formed the covering should be stretched on a light frame in the form of a kite, and should the plane of this kite be tilted a few degrees above the horizontal, it would be found that the atmospheric pressure on the under side of the plane would sufficiently exceed the pressure on the upper side to lift quite as much as a balloon would lift."

The two great experimenters of the present, Prof. Langley, and Harold Maxim, have given over the idea of the balloon entirely, and are now working at the problem of aerial navigation with the aeroplane only.

What a Horse Can Do.

A horse can travel 400 yards in four and one-half minutes at a walk. 400 yards in two minutes at a trot, 400 yards in one minute at a gallop. The usual work of a horse is taken at 22,500 pounds raised one foot per minute for eight hours per day. A horse will carry 250 pounds twenty-five miles per day of eight hours. An average draft horse will draw 1,600 pounds twenty-three miles per day on a level road, weight of wagon included. The average weight of a horse is 1,000 pounds; his strength is equivalent to that of five men. In a horse-mill moving at three feet per second, track twenty-five feet diameter, he exerts with the machine the power of four and one-half horses. The greatest amount a horse can pull in a horizontal line is 900 pounds, but he can only do this momentarily; in continued exertion probably half of this is the limit. He attains his growth in five years, will live twenty-five, and average sixteen years. A horse will live twenty-five days on water without solid food, seventeen days without eating or drinking, but only five days on food without drinking. A cart drawn by a horse over an ordinary road will travel 1.1 miles per hour of trip. A four-horse team will haul from twenty-five to thirty-six cubic feet of limestone at each load. The time expended in loading unloading, etc., including delays, averages thirty-five minutes per trip. The cost of loading and unloading a cart using labor is $1.25 per day and a horse 75 cents is 25 cents a perch—24.75 cubic feet. On metal rails a horse can draw one and two-thirds times as much as on asphalt pavement, three and one-third times as much as on good Belgian blocks, five times as much as on good cobble-stones, twenty times as much as on good earth road, forty times as much as on sand. A modern compilation of engineering maxims states that a horse can drag, as compared with what he can carry on his back, in the following proportions: On the worst earthen road, three times; on a good macadamized road, nine; on plank, twenty-five; on a stone trackway, thirty-three; and on a good railway, fifty-four times as much.

—*Humane World*.

The Hundred-Mile Gait.

Travel at the rate of a hundred miles an hour may soon be no longer a dream, but a commonplace fact, for articles of incorporation have just been filed in Illinois by the Chicago and St. Louis Electric Railroad Company, which proposes to build a road on which wedge-shaped cars, driven by a novel form of electric motor, will make the distance between those two cities in two hours and a half. At first only a double track will be built, but ultimately there are to be four tracks, of which the two outside tracks will be reserved for a local traffic and high-class freight, and the company's plan includes the laying out along the line of broad avenues, facing which will be neat cottages and houses with long, narrow farmlands reaching back into the country. The electric cars are to be long, low, compact, and light, with two pairs of driving wheels, each operated by a motor. Each car will weigh only ten tons, and the wheels will be capable of making five hundred revolutions a minute. A wedge-shaped projection in front, sloping upward, will diminish the friction of the air and will serve to keep the car steady. Light and heat will be provided by electric devices, and neither conductors nor brakemen will be needed. Safety is to be secured by dividing the road into twenty-five sections of ten miles each, so as to constitute a complete block system. One central-power station, six or eight miles from Clinton, De Witt County, Ill., will furnish the electricity required for operating the entire road, and will also provide additional electric power to be let to farmers and residents along the line for their special purposes, and provide for an electric-light plant and a telephone line the whole way from Chicago to St. Louis. This reads like a novel of Jules Verne, but it is not impossible, and the details seem to have been studied with knowledge and intelligence.

—*New York Sun*.

Chicago's Great Danger.

The unenviable experience of Philadelphia with her typhoid epidemic during the Centennial year is likely to have its counterpart in Chicago next year if the city authorities do not soon change the existing order of things. In the first three weeks of this year there were reported 219 fatal cases of typhoid in Chicago—an enormous number, even for that notoriously unhealthy city. The number of fatal cases of typhoid in Chicago in 1890 was 1,008, and in 1891 it reached 1,997, an increase of nearly one hundred per cent. In the Centennial year, Philadelphia had 773 fatal cases, as against 420 in the preceding year. In other words, the death rate from typhoid in Philadelphia in 1876 was 9.36 in 10,000 inhabitants; while in 1890, in Chicago, the rate was 9.16, and in 1891 it reached 16.64. In the single month of May, 1891, the deaths from typhoid in Chicago numbered 408—more than in the larger city of New York in any one whole year since 1887. Naturally Chicago begins to tremble before this menace to the success of her World's Fair, and to seek abatement of the cause. As to this cause, there can be no doubt. It is the pollution of the drinking-water of the city by the city's sewage. Theoretically, Chicago gets its drinking supply from the pure waters of Lake Michigan, and sends its sewage by canal to an affluent of the Mississippi. Actually, the sewage in large part flows through the Chicago River into the lake, surges around on the city shores, and is taken in again, to be drunk by Chicagoans and to carry them off to untimely graves. The water supply of Chicago is obtained from Lake Michigan through tunnels which run out into the lake. Two of them reach two miles beyond the shore line; a shore-inlet tunnel, to be used when one of the others is stopped by ice, runs out only fifteen hundred feet; and a fourth has a submerged inlet five thousand feet from shore. Three other tunnels are now in process of construction; one that will extend out to the United States breakwater, a distance of four thousand five hundred feet, and another extending ten thonsand feet from shore, both of which are to be finished shortly, and a third, the Onderdunk Tunnel, which will extend out four miles into the lake. The last will probably not be finished before October, and not till then can Chicago be reasonably sure of drinking pure water. —*Argonaut.*

Deep-Sea Research.

It was supposed a few years ago that the ocean bottom was largely a counterpart of the land features of the globe, with its mighty mountain ranges pushing up toward the surface of the sea, and deep valleys and glens sinking to almost unfathomable depths. This is found to be true only to a limited extent. Here and there, to be sure, mighty mountains push toward the surface or rise above it, forming islands; and then, again, the bottom sinks in a narrow trough, as off the northeast coast of Japan, until it seems as though the sounding line could never measure its depth. But the ocean bed, in the main, is found gently to undulate, and would appear, if it could be observed, as of a slightly rolling plain. It has been found also that we used to have very exaggerated views of ocean depths. Maury, in his day the great authority upon the ocean, popularized the idea that a depth of eight or nine miles might be found in mid-ocean. We know now that a depth of five miles is very exceptional. General Von Tillo, who has made the latest determinations of ocean depths, fixes the mean depth of all the oceans at less than two and a half miles. The Pacific Ocean averages about 1,100 feet deeper than the Atlantic. The North Atlantic is deeper than the Southern Atlantic, and the Arctic Ocean grows shallower the nearer the pole is approached. Very interesting facts have been discovered with regard to the great distances from land at which the sediment brought down by mighty rivers is spread over the sea bottom. Those giants among rivers, the Niger and the Congo, produce most marked effects upon the nature of the deposits at the bottom of the ocean. Buchanan has found that the sea bed for hundreds of miles from land, from the Gulf of Guinea at Loanda, has been filled up to an enormous extent by the dark-colored soft muds brought down by the rivers; and off the mouth of the Congo the shore mud has been traced to a depth of 18,000 feet at a distance of 600 miles from land. In the Bay of Bengal and the

Arabian Sea the sediment from the Indus and the Ganges is spread out over the greater extent of the ocean's floor. Antarctic ice brings as far north as 40° south latitude the *debris* from lands perhaps still unknown. Before the Challenger expedition, only six deep-sea fishes were known. To-day about ten times as many forms of deep-sea life are familiar to oceanographers. We can form some idea of the abundance of life existing in some regions at a depth of two and a half miles, when it is said that at a single haul of the trawl only twelve feet wide, and dragged over the bottom for a very short distance, as many as 150 specimens of the higher forms of deep-sea life have been obtained. One very interesting fact seems to have been established by the recent investigations in the Pacific of our Fish Commission steamer Albatross. It has long been known that the group of animals characteristic of the upper part of oceanic waters is entirely distinct from the forms of life near and at the bottom of the sea. The Challenger investigators thought they had established the fact that another distinct group of animals exists in the intermediate depths, between these upper and lower forms of life. This theory seems to have been upset by the work of the Albatross. The naturalists of this vessel have found that the forms of sea life in the upper portion of the ocean waters may descend to a depth of 1,200 feet or so from the surface, but there then succeeds a barren zone which continues to within 360 to 300 feet from the bottom where the deep-sea animals begin to appear. As a rule, these deep-sea animals have no eyes, showing that they have no need of them. The fact that they are subjected to enormous pressure is shown by many of them bursting open when brought to the surface. Some of them have very bright colors, and they are found most abundantly along the courses of the great currents, showing that these rivers in the ocean bring a large amount of food for the deep-sea fauna.—*New York Sun.*

QUESTIONS AND ANSWERS.

(*Conducted by Our Readers.*)

NOTES:—1. Hereafter all communications intended for this department, to be noticed, must be signed. We will not publish your name, however, when requested not to do so.

2. We have so arranged with the Sigma Pi Math. Association that all mathematical questions will hereafter be printed and answered in the columns devoted to the Association. Readers everywhere, however, are invited to assist as heretofore.

QUERIES.

40. A man is born in the United States, moves to England and becomes an English subject, then returns, becomes naturalized and remains a citizen of this country the time required by the Constitution. Would he be eligible for the presidency? *W. W. Palmer.*

41. Why is fermentation more rapid in warm weather? *Id.*

42. What material makes the best quality of letter-paper? *Id.*

ANSWERS.

3. Pericles was the greatest statesman that Athens ever had. He had great executive ability and was one of the greatest orators that ever lived. He raised his country to the highest point of political power that it ever reached; he improved its fortifications; built the greatest of its temples; and encouraged in every way that wonderful intellectual life which is the glory not only of Athens but of all Greece. *C.*

4. It is determined by dividing the absolute index of the glass of which the prism is composed by the absolute index for air. The absolute indices for different media are determined by passing a ray of light through them from a vacuum. *H.*

10. The moon's orbit is inclined to ecliptic about 5°, and its nodes (intersections with the ecliptic) move around this circle once in about 19 years. Now, remembering that the ecliptic makes an angle of 23½° with the equator, it will be seen that the inclination of the moon's orbit to the equator varies from 28½° (when the ascending node is at the vernal equinox) to 18½° (19½ years later, when the ascending node is at the autumnal equinox). Hence the meridian altitude, which varies from about 20° to 77°, depends, not on the season, but on the position of the moon's nodes. *B.*

31. By preventing complete fertilization in the flowering stage so that the embryo and seed do not develop. *H.*

32. A thorough explanation of the paragraph of the Cathedral referred to would require more space than can be given it now. The poet maintains that a perfect thing is realized but once. This is true of expression as well as of anything else. There are certain words, or phrases, which once heard we always trace back to some one place in some immortal poem, and there the matter ends,—we seem to have reached a beginning. In the Commemoration Ode, Lowell himself uses the phrase "a shepherd of mankind." A reader of Homer will know at once what was in the poet's mind, the *poimenes laon* of the Greek poet. If I were to use the word "multitudinous," ninety-nine of the hundred readers of Shakespeare would know Macbeth's words were in my mind. If I were to say "the words of my mouth," every one would know what I had been reading. *C.*

37. The circumstance referred to occurred at the siege of Leyden in the Fall of 1574. The inundations of Holland always occur when a prolonged storm from the west piles up the waters of the Atlantic in the North Sea. Such a storm occurred at the time referred to. A few days after the siege was raised, the wind shifted, and there was a tempest blowing from the east. The waters of the sea were driven out, and the land became dry. See Motley, Rise of the Dutch Republic, Part 4, Chap. 2. *C.*

39. Rays of light are polarized when the ether vibrations constituting the ray are limited to a single plane, plane polarized light; or to a single form of movement circular or elliptical, circular polarization and elliptical polarization. *H.*

SIGMA PI MATHEMATICAL ASSOCIATION.

QUERIES.

72. Find the value of x and y in the following equations:

$$x^3+y\,(xy-1)=0$$
$$y^3-x\,(xy+1)=0$$

C.M.J.

73. A tree 300 feet high breaks, the top striking a stub 160 feet high. The part broken off produced will meet the ground 200 feet from the base of the stump. What is the length of the part broken off? E. B.

74. A speculator loaned \$640 in the state of Nevada for 96 days, \$1200 in Kansas for nine months and 27 days and \$2800 in Oregon for 5 months and 12 days. The rate % per annum in Oregon for which he received interest was 10%. If 75% of the rate per annum allowed him in Nevada was equal to 66⅔% of the rate per cent. per annum allowed in Kansas; and 66⅔% of the rate per cent. per annum in Kansas was equal to 60 per cent of that of Oregon; how much was the total received for interest on the sums loaned in the three states? C. T.

(Ex. 32, Page 236, Saddler's Counting House Arithmetic.)

ANSWERS.

66. $59.50+$282.85=$342.35, amount of liquor.

$342.35—$81=$261.35, amount of liquor sold.

$293.55—$261.35=$32.20, gain.

$32.20+$58=$90.20, amount cleared by agent.

$90.20—$69=$21.20, amount agent owes town.

$59.50+$58=$117.50, amount paid to agent by town.

$117.50—$81=$36.50, loss of town.

But in case the agent pays the town the $21.20 due it, the loss will be $36.50—$21.20=$15.30.

G. T. Cass.

PROGRAMMES.

44. July 2.

Continued Fractions, T. G. Rodgers

Exs. 1–16, inclusive, Pages 369-75

45. July 16.

Reduction of a Quadratic Surd to a Continued Fraction, J. C. McGhee

Exs. 10, 12, 13, 16, 19, 22, 24, 28, 30 and 36, Pages 375-87.

46. July 30.

Continued Fractions, D. D. Feldman

Exs. 1-10, inclusive, Pages 515-31.

NOTE.—The Association thinks of securing Todhunter's Geometry for the next year's work, and also of purchasing books for a library. But it would like very much to have the sentiment of the absent members who would be interested in the work. Any one wishing to suggest a text-book for the next year or any particular book for the library, please write to L. M. Troup, Corresponding Secretary, and the suggestions will be considered at the next regular meeting of the Association.

THE EDITOR.

Vacation.

Now that the schools have closed, thousands of teachers are forming their plans for the vacation that is on their hands to be disposed of. What disposition shall be made of it? Of course, the first consideration is rest. If the teacher has been faithful in his work, he needs rest, and is entitled to it. Indeed, must have rest, if he is to hold his position in the ranks; much more, if he is to command a better position. As well might it be expected, that to-morrow's work shall be well done, if the wear and tear of to-day is not repaired in sleep. But we are coming to understand, that real, healthful sleep is something very much more than simply a process of patching and darning. Not only does it "knit up the raveled sleave of care," it carries on to the end in an unconscious, or a subconscious, way the most vital work of the waking hours. Precisely so should the vacation be spent by the teacher. If he has found his work hard in the school-room, nine times in ten the hardness has come from his occupying a position which he was not fitted for; and in simple justice to himself, he should fit himself honestly for his position, or expect nothing from "the blessed gods or mortal men." If the best thing for him to do is to go into the wilderness for forty days and forty nights, let him go into a real wilderness, and not into the metaphorical one which we popularly call society. No doubt, it becomes necessary once in a while to get away entirely from one's work, but in the great majority of cases what is needed is to get more intimately into it; and usually the only change needed is a change of environment, without any change in the atmosphere. It is matter for very serious doubt whether the teacher has been breathing a truly intellectual atmosphere if he finds it necessary to get into one that is less intellectual. His health, his finances, or other necessities may, indeed, make it impossible for him to keep up a very intimate connection between his vacation work and his regular work, but the connection cannot be absolutely severed without serious loss to the latter. And there are many things which he may do for himself, no matter what his situation may be, to keep up the connection. If there is some particular part of his work which has given him trouble, he might get some new book on the subject and work it through alone. If there is a teacher who has never read the book, let him read either Whitney's or one of Dr. Morris's little works on grammar. If he needs nothing in that line, let him do something with the botany or geology of his neighborhood, using some good book like Wood or Gray; or let him read Dr. Geikie's little book of sketches or Dr. Hutchinson's on how mountains and hills are formed. If he does not care for any of these, let him read some piece of real literature, some good prose translation of the Iliad; or Gilbert's or Genung's translation of the Book of Job; or some volume of Ruskin, the Sesame and Lilies or the Crown of Wild Olives. Whatever he reads, let it be something that is genuine, none of the namby-pamby things fixed up for Summer Resorts. There is such an abundance of matter of this kind, that the teacher who knows nothing of what it is ought to feel that he is not so far away from the ancestral anthropoid as good breeding might demand.

If the financial, or other, necessities will permit it, there is truly no excuse now for the teacher's not going to some real school and doing real work in his line, which will prove not only a rest and recreation, but a positive help and inspiration in all his work. There are so many Summer Schools now, in which every conceivable subject is taught, that every one may find just what he needs to supplement his present acquirements and strengthen any weaknesses that may have been discovered in the real work of the school-room. It must be confessed, that some of these schools seem to have been organized for the constitutional weaklings of the profession, but there are many others that are real, and to which one may go and not feel that he has dropped into an asylum or sanatarium. There may be none just equal to that historic one held in the barn on Penikese, which Dr. Jordan and Whittier have celebrated in eulogy and song, but there are still honest teachers, and capable ones, to whom the young teacher may commit his interests with perfect confidence.

The Rights of Children.

An article appears in a recent number of *The Arena* on the Rights of Children, which, though addressed to parents rather than school teachers, contains much that is pure gold for our profession. In our anxiety to teach facts,—so much grammar, so much arithmetic, so much geography, to so cram the minds entrusted to our guidance with information of one sort or another, that such or such per cent. may be reached on examination day,—we are pretty apt to forget and entirely lose sight of our noblest and best privileges, and highest duties. The thoughtful teacher, who really wishes to do permanent good, will be benefited and inspired by the following extract which I make from the paper referred to. Its author is Rev. M. J. Savage, of Boston.

"The child has a right to be educated into a fitness for self-support; and this is a right the importance of which is growing constantly with the spread over the earth of democracy, and with the social and industrial ideals which we believe in and cherish in this country. This is the prime end, in my judgment, of education. Teach the child, boy or girl, that he or she has come into a world that is not rich, but that is comparatively poor; a world where he has no right to take away from the store of accumulated wealth without adding at least as much, by his own effort, in its place. In other words, the first quality of manhood or womanhood, in my judgment, is this. It is the basis of all honesty in dealing with mankind. Each child should insist, as it goes through the world, on being of as much use to the world as the world is to it, so far as possible. It is not a matter of prime importance as concerns poor children alone. I do not need to insist on this side of the subject in dealing with poor children, because they must do it, whether they will or not. But I think it is of prime importance that fathers and mothers whose children do not "need" to do it, as they say, should learn the lesson, and teach it to their children. Thousands of young men are every year spoiled for the highest ideals of manhood merely because they can say, 'Father's got enough, and it does not make any difference what I do.' That canker eats into and eats out the essence of all manhood, until these men not only take out of the world's store of accumulated wealth, but they become examples of all that is disintegrating and dishonoring in social, industrial, and political life. No matter how you do it, but teach your child, as a matter of the greatest importance, that it is her business or his business to look upon the things of this world, its accumulated results, as an inheritance, not earned, nor theirs of right, but something intrusted to them, and which it is their business to transmit to the next generation, not only unimpaired, but, if possible, augmented, and so made the means of still mightier good in the years to be.

When you have taught your child self-support, when you have taught it the principles of right and wrong, the ideals of a noble life, then you may enter, if you will, the other field, which sometimes is regarded as being the principal thing in the matter of education. Teach these things first that I have pointed out, —self-support, the main lines of right and wrong as they run through this world; and then for the joy of the child, for the enrichment of the child's life, put into that child's hand, if you can, the keys by which to unlock all the world's storerooms of inherited wisdom and achievement. Make the child able to enter into the world's literature. Make the child able to understand the world's achievements in poetry. Make the child able to at least catch something of the meaning of the wonders of the world's music. Teach the child at least the rudiments of the language of the world's art, so that he may walk the picture galleries of earth, and have the masterpieces of the ages speak to the imagination, heart, and soul; that he may walk the sculpture galleries of the world, and commune with Phidias, with Michael Angelo; may be able, at least, to gain a glimpse of the magnificent visions of beauty that dominated these great lives. Teach your child, after he has learned the principles of right and wrong, after he has learned how to enter into life's great inheritance, to find here inspiration, loyalty, and respect for the possibilities of mankind.

But there is one thing more. Too many educated men and women wander selfishly, aimlessly, through these fields of the world's past achievement, and become *dilettanti*, admirers only of that which is great. I was very glad to learn the other day of a lecture which had been given in Cambridge by Professor Charles Eliot Norton. I suppose there is no man in America more highly, truly, and delicately cultured than is he. He is the one man fitted to be merely *dilettante*, if he chose, with every faculty and taste keenly alive to everything that is beautiful and fine in the literature, art, and architecture of the world. I was glad, I say, to find that, in addressing the students of Cambridge, he pitched his key-note to something magnificently high, something grand, when he told the students that the one thing that Harvard University ought to exist for, the one thing that they ought to place before them as the grand ideal of their lives, was a noble citizenship in this republic,—manliness, which means service of one's fellows. He told them—what I wish could be echoed in the ears of all the young men of America until they could never forget it—that as yet even this republic is but an experiment, but that it carries with it the last and highest trust and hopes of the race in the way of liberty, in the way of industrial civilization, in the way of a free and independent manhood, so that the highest outcome of the education of every young man or young woman ought to be to teach them to appreciate the value of this grand heritage that has come to us here in this country; that they should feel that the one thing that the knowledge of Greek or Latin, or German or French, of literature, of poetry, of music, of sculpture, of painting, of history, of architecture, of anything,–or a knowledge of all these things,–the one thing they ought to culminate in is simply a self-poised man. He knows that these things are to minister to one's manhood, and that with his manhood he is to minister to his country. He knows that this ministry to his country is only the indirect service which he as a man is to render to mankind."

The Great National Conventions.

There are many valuable lessons to be learned by the teacher in observing the work and management of a national convention. The personnel of such a gathering is worthy of study. From the most prominent men in the Nation to the dapper little camp-follower who is a "hanger on" to the coat-tails of some eminent politician, every one has a personality which he hopes to project into the campaign. Every one thinks he knows just what must be done and how it must be done, in order to save the party from ruin. The wise old politician who has participated in so many battles, wrinkles his brow and states in a positive way the exact situation and tells just how it has always been and will be again. His wisdom must be incorporated in the platform, hence he is consulted by the committee, and is the power behind the throne in the formulations of "principles." The Republican Convention which has just met at Minneapolis was in many respects a remarkable one.

The "Plumed Knight," James G. Blaine, the ideal Republican Statesman, the pride and boast of his party, was represented by a large class of "regular" politicians, and others who placed devotion to man ahead of availability. They loved their man, believed in him, and called it political sacrilege not to support him. They felt that he is growing old and with him it was "now or never". But the rank and file of the convention were not given to sentimentalities, and while they did not love Blaine the less, they loved success the more, and believing that the chances of success were greater with Harrison at the head of the ticket than with Blaine, they supported Harrison and made him the nominee.

Thus is Jas. G. Blaine relegated to the company of Clay and Webster, and in the annals of our country his fame will rank with theirs.

Whether or not the convention did a wise thing remains to be seen. President Harrison has shown himself not only a capable and fearless executive, but an astute politician. While he has managed the affairs of State with great skill, he has not neglected to look after the partisan political "wires."

The great Democratic Convention which met at Chicago, in many respects resembled the Republican gathering at Minneapolis. The great leaders were present, and the principal work as usual was done before the full organization was completed. In fact, as at Minneapolis, the convention proper simply gave the official sanction to the work that had been done by the committees and in caucus. The nominee, Grover Cleveland, was no doubt a wise choice for Democracy. The masses of the party desired his nomination. His record is good and like Harrison he will point to what he has done and say, "Who can do better?" The campaign will no doubt be hotly contested, and the tariff will be the main issue.

The Republician platform affirms adherence to the doctrine of Protection and the Democratic platform declares in favor of Tariff for revenue only.

The position of each is well defined and for once it is believed the case will be tried on its merits.

The people are to be congratulated on the fact that this year the platforms of the two great parties are not made to conceal the principles but to express them in a concise and forcible way. There need be no quibblings or personalities enter into the canvass. Let it be an intelligent, honorable, and manly contest and no matter who shall be elected the country will be the better and wiser for having had the campaign.

The Crescent.

The following are the officers for the summer term: Pres., A. H. Kreiling; Vice Pres., M. X. Geske; Rec. Sec., Jennie Fulton; Treas., E. Harraman; Cor. Sec., Martha Fulton; Critics, P. H. Moroney and Minnie Davis; Choristers, Sophene Johnson and R. E. Campbell; Marshals, J. P. Frantzen and J. B. Dandridge; Executive Com., Lottie Hohn, H. Ruring and M. X. Geske.

C. M. Eby, of Cassopolis, Mich., is candidate for Judge of Probate. He is a good man for the place and his chance of being elected is favorable.

Minnie Wirt reports that she has a pleasant time teaching music in the Normal, at Chillicothe, Mo., and that she will spend her vacation at home, and be with us during commencement.

Charlie Holt, of the popular "H Trio," is visiting at his home in New Hampshire. His school year at Ann Arbor has been crowned with success. He has not only won honors as an orator, being the orator of his class, but he is one of the best in athletics. He will continue his studies at Ann Arbor next year and spend the summer of '93 at Valpo. Mr. Howe is at his home in Southern Ill., and Mr. Harmon is again in our midst. Many miles separate the members of the "Trio" now, but we hope that sometime in the future they may be brought together again and that we may be permitted to listen to another of their very interesting entertainments.

Eugene Peavler, one of the best of the law graduates of this year, in partnership with William Hughes has hung out a shingle at Whiting, Ind. Success is theirs, as a stronger firm could not have been formed from the class of this year.

We have lost one of our valuable members, as C. G. Hankey has been called home. We hope to have him with us again next year.

A number of Crescents, having taught successful terms of school, have returned to Valpo, to spend their vacation. Among these are E. H. Stroeter and Joseph Conroy.

The friendship of the Stars has been extended to us again, as they gave their program on Friday evening, granting us Saturday evening, June 18. On this evening, although cloudy and damp, Old Chapel was brilliantly lighted by the radient countenances of the Crescents intermingled with those of their visitors who came to help enjoy the annual festival. All seemed to enjoy the music by the city band; the bananas, ice cream, strawberries, and other delicious eatables. Considering the weather the affair was very successful. J. C. M.

The Star.

Miss Verta Warfield has spent several weeks at her home at Sandoval, Ill., since the close of her school in this county, and is again in school, with the intention of remaining next year.

G. G. Feldman, graduate of the Law class of this year, is spending his vacacation in the interest of a Chicago School Supply Co. He intends taking the Post-graduate Course in Law at Ann Arbor next year.

Miss Vesta Meader closed a successful and pleasant term of school at Whiting, Ind., June 24. She has been elected to a position in the new Ward School of this city, for the ensuing year.

Quite a number of old students visited us during convention week, the following Stars being among the number:—T. M. C. Hembroff, Scientific and Classic of '89 and '90; F. P. Manly, Scientific of '89, E. E. Hipsher, of the Music class of '90, and Misses Ella Baker and Cora Lingle, of the Music class of '91.

Among the old students in school this term we notice the following old Stars:—A. E. Baker, Scientific of '91, Fred Stroup, Scientific of '90, F. P. Young, Scientific and Classic of '89 and '90, N. C. Stott, Scientific and Classic of '89 and '90, E. N. Worth, Scientific of '90, W. A. Hill, Scientific of '89, Harvey Waite, of '91, Addie Clark, Scientific of '91, Mary Wertman, of the Music Class of '89, Maxwell Adams, Classic of '91.

At the last regular meeting of last term the following officers were elected for the Summer term: Pres., L. M. Troup; Vice Pres., H. A. Miller; Rec. Sec., Belle Hogan; Cor. Sec., Lizzie Baker; Treas., Frank McNulty; 1st Critic, John McCulloch; 2nd Critic, Grace Freeman; 1st Editor, H. H. Stanbury; 2nd Editor, Vesta Meader; Commissioners, A. D. Blake, J. E. Lung, and B. B. Riggs; Vocal Chorister, Vertie McAlister; Ins't. Chor., J. L. Hayward; 1st Marshal, S. H. Johnson; 2nd Marshal, Rosa Brown.

M. C. L.

WHAT THEY ARE DOING.

G. M. Voris is spending the summer at Petoskey, Mich.

Sylvester Thompson is still doing good work in the schools of Winslow, Indiana.

D. P. Repass is doing good work as County Superintendent of schools in Audubon County, Ia.

Ira J. Bradley has been engaged as principal of the Boyden, Iowa, city school for the coming year.

Miss Mollie Beattie has finished a successful year's work at Sikeston, Mo., and returned to her home in Commerce, Mo.

W. W. Palmer will hold a Summer Normal in Van Wert, Iowa, beginning August first. He is a very popular teacher.

John S. Welch recently finished his year's work in the public school of Morris, Minn., and will probably remain in the same place another year.

D. W. Whipple has, for several years, been the popular principal of the Oro Fino, California school. Charles Hinshey who was here in '85, I believe, is also located in California.

C. J. Hutchison has been retained another year in the schools of Brazil, Indiana, at an increased salary. I always like to get such reports as this. "Have been retained at an increased salary" speak volumes.

The directors of the Cabool College, Mo., have re-engaged E. McCulley as president of the college. In a circular letter they express themselves as being more than pleased with his efficient work, and with what he has done for the college.

I received a very pleasant call from J. W. Walker, the courteous and able representative of the American Book Co. Mr. Walker was in school in '76, '77, and '78. He has an excellent position and is doing well.

A. E. Compton's name appears on the Democratic ticket of Jasper Co., Ill., for the position of County surveyor. Inasmuch as the county goes from 500 to 700 Democratic, and as Mr. Compton is well known and popular in that county he will undoubtedly be its next surveyor.

A very handsome program announces the closing exercises of the Hammond, Indiana, High School, which for years has been under the efficient supervision of W. C. Belman. Mr. Belman is a rising teacher, and one of my most valued contributors.

E. M. Barber, in a very kind letter, informs me of his promotion to the position of manager of the first department of book-keeping in the Packard, New York, College. Mr. Barber is an energetic, rising young man who makes his influence felt wherever he works.

W. E. Harmon has been re-employed as superintendent of the Bozeman, Mont., schools at a salary of $1,800.00, —an increase of $200.00 over last year. Mr. Harmon is becoming one of the foremost teachers of his state.

Clarence E. Hatchett who graduated from the Law department this year, in renewing his subscription for THE STUDENT laughingly promised to send the money when he should win his first case. Mr. Hatchett's first case turned out to be one of some importance, in Quincy, Ill., and he won it.

One of Tulare, California, papers in a column article on the Tulare City schools, gives H. C. Faber, of '80, the following complimentary notice:

When Prof. Faber began his principalship he stated to a *register* representative that it would be his purpose to bring the school and its patrons nearer together. How admirably he has succeeded need not be told by us. During the two years he has been in charge of the school, he has won the esteem and the confidence of the parents and pupils to a degree not often attained.

E. F. O'Riordan writes a short note to THE STUDENT as follows:

I closed my term of school on May 20th to the entire satisfaction of my trustees, and before I left they requested me to teach for them another year, but I have moved westward to look for something better. I am spending my vacation handling Colorado and Arizona fruit for a firm in this city. (Tucson, Arizona.) I have been offered a position as reporter for one of the daily papers here, so that I can develop either brain or muscle, as I may choose, during vacation.

Joseph Conroy did such good work in the schools of Lake Co., last year that he has been elected assistant principal of the Hobart Schools at the salary of $75.00 a month.

With P. S. Gristy as principal and Mr. Conroy as assistant, efficient work will certainly be done the coming year.

Elmer Watts, who has been teaching for some time in Oregon, has been recently elected principal of the Celone schools at a salary of $75.00 per month. In a kind and complimentary letter he says that he likes the West well, and that he thinks it the place for the wide-awake and energetic teacher.

I was glad to see Mr. O. K. Wheelock who made me a pleasant call during the month. He is traveling for a Bedford, Ohio, Chair Co. He is greatly interested in his business, and is growing more and more successful every year.

Mr. Wheelock furnishes the following information concerning some of our old students:

H. C. Sanford, surveying class of '90, is engaged in the construction of the great tunnel that the Baltimore and Ohio Railroad Co. is construct ing under the city of Baltimore.

Mr. Sanford is thus assisting in the construction of what will be one of the most notable engineering feats of this age.

A. B. Frost, Scientific of '90, will be the next county surveyor of Jay County, Indiana.

H. L. Smith has a splendid position with the county surveyor of Cuyahoga Co., Ohio, and is located in Cleveland.

F. J. Heller is practicing law in Columbia City, Indiana.

L. C. Libby is prospering finely with his school at Carthage, Texas.

Lena Wheelock is teaching in the Bedford High School, and lives with her parents.

BOOKS AND MAGAZINES.

The July MONIST is an unusually valuable number of the high-class quarterly. There is a very clearly stated article on the Unitary World-view, by Prof. Haeckel; an instructive article on Magic Squares, by Prof. Schubert; one on the Law of Mind, by Chas. A. Peirce, a son of Prof. Peirce of Harvard. There are the customary reviews and notices. The editor, Dr. Carus, contributes two or three most instructive papers. This quarterly deserves to be sustained as one of the most creditable publications of the country.

The American Book Co. have recently issued a Laboratory Manual of Chemistry by Armstrong and Norton. It is one of the best books on this subject that has come under our notice. It is brief, comprehensive and lucid. It leads the learner experimentally step by step from the simplest chemical phenomena along the lines of fundamental principles to a clear understanding of the subject. The authors have so carefully and systematically arranged the experiments and given such clear explanations that a student could almost get on without an instructor. Such a book has been needed for a long time. It makes it necessary and interesting for the pupil to think for himself. The arrangement for notes on blank pages opposite the experiment is an excellent feature.

Kindergartens—Manual Training—Industrial Schools, is the title of a stimulating article on present educational problems, contributed to THE POPULAR SCIENCE MONTHLY for July, by Mrs. H. M. Plunkett. It should be read by every teacher. Other fine articles are *New and Variable Stars,* and some interesting considerations on *The Waste and Gain of the Dry Land.*

There are perhaps few readers but would find something of interest in the COSMOPOLITAN for June. Its table of contents is the most varied of any journal that comes to our table. The introductory chapter of a series of papers on *Evolution and Christianity* by St. George Mivart is too discursive to be of great interest in itself but awakens interest in what is to follow. *The Aeroplane* by that authority in aerial navigation, Hiram S. Maxim, effectually explodes many groundless theories and hopes entertained on this subject. Other capital papers are *The Town Meeting* by E. E. Hale, *Our Fur Seal Rookeries* by H. W. Elliott, and *Our National Political Conventions* by Murat Halstead.

The ATLANTIC MONTHLY for July contains an impartial account of the part played by Gen. McClellan in the war, and an able summing up of his weaknesses and elements of strength. It is getting to be the thing to publish articles on Chicago, and Edward G. Mason's, in this issue, is perhaps as satisfactory as any that have yet appeared. Theodore Roosevelt contributes a reliable paper on the *Political Assessments in the Coming Campaign,* and the two most valuable articles from a literary standpoint are *Looking Toward Salamis* by William Cranston Lawton, and Miss Vida D. Scudder's *The Prometheus Unbound of Shelley.*

The July issue of THE CALIFORNIAN, essentially a summer number, contains 160 pages of reading matter and a large number of striking, and beautifully executed engravings. *The Schools of San Francisco*, by F. H. Hackett, is interesting and contains a very detailed account of the various schools of that city. *Pompeii* is a richly illustrated article giving an acconnt of the ancient city in the light of the most recent excavations. —A very handsome number.

No more useful and generally excellent number of the ARENA has ever been issued than the one for June. *Ether and its Newly Discovered Properties*, by Prof. Dolbear, *The Rights of Children*, by Rev. M. J. Savage, *The Democracy of Darkness*, by the able editor, and *The True Basis of Currency*, by Miles H. Dawson are all thoughtful papers prepared by able men, and well worth study. Nor must we forget to mention Rabbi Solomon Schindler's plea for more male teachers in the public schools. In this age and country it may sound in bad taste and ungallant enough to say that the preponderance of female teachers in our public schools is a flaw in the system, but the Rabbi's points are well taken and it would be difficult to refute his arguments.

The July OVERLAND MONTHLY comes to us in a new and attractive midsummer cover, and is an excellent number both in fresh and entertaining subject-matter and variety and beauty of its illustrations. It is a very delightful issue, and furnishes most seasonable entertainment.

THE SCHOOLMASTER IN LITERATURE is the title of an unique book recently issued by the American Book Co. It must be confessed that the place of the schoolmaster in the English literature of the past is not an enviable one, yet the researches of the scholarly editor of THE SCHOOLMASTER IN LITERATURE shows that the teacher is not always an object of derision. The book is made up of many, yet not too many, extracts from writers, in various ages, on teachers and teaching. No teacher can read it without being encouraged and assisted in his work. Edward Eggleston furnishes the introduction, but we are proud to say that the editor, whose scholarship and refined taste is shown in every extract the book contains, is one of Valparaiso's sons.

The July WIDE AWAKE contains a stirring Revolutionary story by Adelaide Cilley Waldron, the chief incident of which furnishes the frontispiece for the number. It is called *Jock's Journey*, and is full of dramatic action. The *Flag on Top* is a novel and humorous Fourth of July story, with California surroundings by G. Adams; Edith Robinson's quaint Marblehead story, *Betty Martin's Ghostly Grandfather* is delightful in motive and denouement. Charlotte M. Vaile has a Denver Fourth of July story, *Benny and the Major* which young and old will alike enjoy, and still another brief story celebrates the Fourth, Grace Stuart Reid's *A Grasshopper's Fireworks*. Harriet C. W. Stanton contributes another of her delightful literary-descriptive articles, *Sir Philip Sidney and his Oak*, illustrated from Penshurst photographs, and Lieut.-Col. Thorndike has a sketch of adventure, *In the Changing Monsoons*. The number is an excellent summer issue, readable in every page.

In going over the July magazines, all western readers will turn at once to Franklin H. Head's article on *The Heart of Chicago*, in the current NEW ENGLAND MAGAZINE. It shows the metropolitan characteristics of Chicago as they have not been shown before; and its contemporaneity is the best record of the city's progress. It is finely illustrated by J. O. H. Hatfield, Charles H. Woodbury, and others. Another valuable article is that of Prof. Elihu Thompson who outlines the possibilities of electricity in domestic and commercial life. He is of the opinion that before long electricity will solve the domestic servant question, rapid transit, and completely revolutionize our manufacture and social economy. Prosper Bender contributes an interesting paper on *The French Canadians in New England*, showing how they are invading the country. The number is a good one.

PUBLISHER'S PAGE.

THE STUDENT.

M. E. BOGARTE, EDITOR.

H. N. CARVER, MANTIE E. BALDWIN,
ASSOCIATE EDITORS.

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THE STUDENT,
108 COLLEGE AVE. VALPARAISO, IND.,
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Prof. William J. Hussey has accepted the chair of Astronomy of the Leland Stanford Jr. University, and is much pleased with his new work.

In consequence of his removal from Ann Arbor the extra labor thus entailed, he has been unable to prepare the Astronomical Notes for July, but his articles will appear again in our August issue and regularly thereafter. They are becoming a very popular feature of our journal and are eagerly looked for by thousands of readers.

* * *

Students in school who are regular subseribers to THE STUDENT will, hereafter, get their journals on publication day at our office. This will save many vexatious delays.

* * *

Dear Reader, if you are not already a subscriber to our journal you are cordially invited to thoroughly examine this number and see whether THE STUDENT isn't about what you want. It speaks for itself, and is gaining in popularity more rapidly than any journal of its kind, published in the West.

* * *

If you are willing to increase the circulation of THE STUDENT and are unable to represent it yourself in your institute, you can place us under great obligation by sending us on a postal card, the name of some live teacher who would be likely to wish to do so. Our terms to agents are very liberal.

* * *

M. C. Kelly will conduct the usual annual excursion to Niagara Falls, leaving Valparaiso Monday morning, Aug. 15, and reaching the Falls Tuesday, morning. Arrangements can be made for excursionists to remain as long as they choose at the Falls and return on any regular train via. the Nickel Plate Road. The fare for the round trip will be very low, $7, and every thing that experience can suggest will be done for the comfort of those desiring to go. It will be a rare chance to visit Niagara.

* * *

Hobart and Kennedy's Souvenirs of College Hill are now ready for delivery. They are very beautiful, and will prove very interesting to those who contemplate coming here, as well as to students who have been here.

* * *

COOL SHADE,

Can be found at Vermillion, O., and those who wish to attend the Camp Meetings at that place during July and August can procure excursion tickets via the Nickel Plate from June 21st to August 33rd at special rates.

* * *

CAMP MEETINGS AT VERMILLION, O.

Excursion tickets on sale via the Nickel Plate from June 21st to August 23rd at very low rates. Tickets good returning until August 36th.

MAY EXAMINATION QUESTIONS FOR INDIANA.

READING.

"I wandered lonely as a cloud,
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host of golden daffodils;
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze."

— *Wordsworth.*

1. Why is it a fundamental requsite of expression, that attention to and admiration of nature be cultivated? 10
2. How is the above extract fitted to excite these qualities? 10
3. Give five questions showing your method of inciting an unappreciative child to feel the beauty and get the thought in this selection? 20
4. (a) How is the above extract fitted to cultivate the imaginative faculty of the mind?
   (b) Why is it important that this faculty should be cultivated? 10
5. Read a selection. 50

ANSWERS.

1. The prime requsite of a good reader is sympathy,—particularly sympathy with humanity, but also sympathy with and love for nature in all her forms.
2. It is attractively expressed, within the scope of the pupil's understanding and experience, and breathes the geuuine enthusiasm of the great poet.
3. How do you do when you are lonely ? How did Wordsworth? What do you know of his love for flowers and birds? Will you tell me all you know of daffodils? Did you ever think of beautiful flowers as friends, always ready to please you, and make your life pleasant?
4. (a) The imagination is the faculty which forms ideals and images; it is the picture-making faculty. The stanza furnishes an excellent basis for a mental picture—something to be seen by the mind's eye. The poet wandering lonely, with no aim and no fellow interests, a mere cloud floating far away from the earth where human sympathies are; the host of golden daffodils "beside the lake beneath the trees," down low, on the earth, fluttering and dancing,—surely those things make a picture. The last stanza of the poem should be read in connection with the one quoted.
   (b) Without some form of the imagination, the mind can do no new work,—it must just go on using what it already has.

ARITHMETIC.

(*Answer any eight.*)

1. What principle is involved in reducing fractions to a common denominator?
2. Three trains on parallel tracks are running between Chicago and Milwaukee. They can make the round trip in 8, 10, and 12 hours respectively. If they leave Chicago together on January 1, at noon, when will they again leave together?
3. Explain how to reduce a mixed number to an improper fraction, and show the reason for each step.
4. What number must be taken from $27\frac{5}{9}$ so that the remainder may contain $5\frac{1}{7}$ an exact number of times ?
5. Bought 20 lbs. opium at 55c per oz., Avoirdupois, and sold it at 60c per oz., Troy. Find gain or loss.
6. Three-fourths of the selling price of goods is 20% less than cost. Find the gain % at which the goods are sold.
7. A man rides to town and walks back. He is is gone 3 hrs. and 45 min. He could ride there and back in $2\frac{1}{2}$ hrs. How long would it take him to walk there and back?
8. $$\frac{3\frac{7}{9}\times 1\frac{1}{17}+4\frac{1}{12}-3\frac{9}{16}}{5\frac{1}{9}-7\frac{7}{8}\div 28\frac{7}{20}+\frac{1}{3}}=\text{what?}$$
9. What must be the face of a note for 3 months made on Aug. 18, so that discounted at $7\frac{1}{2}$ % on the day of making at the bank the proceeds may be $14,315?

ANSWERS.

1. A common denominator of two or more fractions is a common multiple of their denominators. Also, multiplying both terms of a fraction by the same number does not change the value of the fraction.
2. Any common multiple of the numbers, 8, 10, and 12, will denote the time when they will all be together again in Chicago, and the L. C. M. will denote the time when they are together again for the first time after Jan 1.
   L. C. M. of 8, 10, 12 is 120.
   ∴ The will first be together again in Chicago in 120 hrs. or 5 da. Jan. 1, at noon,+ 5 da.=Jan. 6, at noon.
3. Any mixed number is equal to the integral part plus the fractional part; and any integral may be regarded as a fraction whose denominator is unity, and may, therefore, be reduced to a fraction having any desired denominator by multiplying both terms by the desired number. Hence, the rule.
   Ex. Reduce $7\frac{5}{8}$ to an improper fraction.
   1. $7\frac{5}{8}=7+\frac{5}{8}=\frac{7}{1}+\frac{5}{8}$.
   2. $\frac{7}{1}=\frac{7}{1}\times\frac{8}{8}=\frac{56}{8}$, multiplying both terms of fraction by the same number does not alter its value.
   3. ∴ $7\frac{5}{8}=\frac{56}{8}+\frac{5}{8}=\frac{61}{8}$. Ans.
4. $$\frac{27\frac{5}{9}}{5\frac{1}{7}}=\frac{\frac{248}{9}}{\frac{36}{7}}=\frac{\frac{1736}{63}}{\frac{324}{63}}=5\text{, and }\frac{116}{63}\text{ remaining.}$$
   $\frac{1736}{63}-\frac{116}{63}=\frac{1620}{63}$
   $\frac{1620}{63}\div 5\frac{1}{7}=\frac{1620}{63}\times\frac{63}{324}=\frac{1620}{63}$ or 5.
   ∴ If $\frac{116}{63}$ be subtracted from $27\frac{5}{9}$, the remainder will be exactly divisible by $5\frac{1}{7}$.
5. 20 lbs.=320 oz.

320 oz. opium @ 55c per oz $=\$176$, cost.
1 oz. Av. $=\frac{175}{192}$ oz. Troy.
320 oz. Av. $=320\times\frac{175}{192}$ oz. Troy $=\frac{56000}{192}$ oz. Troy.
$\frac{56000}{192}$ oz. @ 60c per oz. $=\$175$, selling price.
$\$176-\$175=\$1$, the loss.

6. 20% less than cost $=80\%$ of cost.
$\therefore\ \frac{3}{4}$ of S. P. $=80\%$ of cost.
$\therefore$ S. P. $=\frac{4}{3}\times80\%$ of cost $=106\frac{2}{3}\%$ of cost.
$106\%-100\%=6\frac{2}{3}\%$, the gain.

7. Riding:
1. 2 times distance $=2\frac{1}{2}$ hours
2. 1 time " $=1\frac{1}{4}$ "
3 But 1 time distance riding + 1 time dist. walking $=3\frac{3}{4}$ hours.
*4. $\therefore$ 1 time distance walking $=3\frac{3}{4}$ hr. $-$ $1\frac{1}{4}$ hrs. $=2\frac{1}{2}$ hours.
Walking:
1. $\therefore$ 2 times distance walking $=2\times2\frac{1}{2}=$ 5 hr. 2. $\therefore$ It would take him 5 hours to walk there and back.
*Rem.—The 4th equation is gotten from the third by subtracting equals from both its members.

8. $$\frac{3\frac{7}{9}\times1\frac{1}{17}+4\frac{1}{12}-3\frac{9}{16}}{5\frac{1}{9}-7\frac{7}{8}\div28\frac{7}{20}+\frac{1}{3}}=\frac{\frac{34}{9}\times\frac{18}{17}+\frac{49}{12}-\frac{57}{16}}{\frac{46}{9}-\frac{63}{8}\div\frac{567}{20}+\frac{1}{3}}=$$
$$\frac{4+\frac{49}{12}-\frac{57}{16}}{\frac{49}{9}-\frac{63\times20}{8\times567}}=\frac{\frac{388}{48}-\frac{171}{48}}{\frac{24696}{4536}-\frac{1260}{4536}}=\frac{\frac{217}{48}}{\frac{23436}{4535}}=$$
$$\frac{217\times4536}{48\times23436}=\frac{7}{8}.\ \text{Ans.}$$

9. Bank discount of \$1 for 93 da. @ $7\frac{1}{2}\%=$ \$.019375.
\$1.00 $-$ \$.019375 $=$ \$.980625, proceeds of \$1.
\$.980625 proceeds require \$1 F.
\$1 " requires $\frac{\$1}{.980625}$ F.
\$14315 " require $\$.\frac{14315}{980625}$ F., or \$14,597.833+

GRAMMAR.

"Fourscore and seven years ago, our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battle field of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this. But in a larger sense we can not dedicate, we can not consecrate, we can not hallow this ground. The brave men, living and dead, who struggled here, have consecrated it far above our power to add or detract. The world will little note, nor long remember, what we say here, but it can never forget what they did here."—*Abraham Lincoln.*

1. Give construction of each of the two "thats" in the clause "who here gave their lives that that nation might live."
2. Show construction and use of the clause "that we should do this" found in the next sentence.
3. Parse "dedicated" in the next sentence. What is the case of "power" in the last sentence?
4. Give construction of "resting place" found in the third sentence.
5. What does the clause "All men are created equal" modify?
6. Give case of "years" in the first line.
7. Give construction of "testing" found in the second sentence.
8. Write five complex sentences each differing from all the others in the mode of its construction and explain what constitutes it a complex sentence.

ANSWERS.

1. The first "that" is a subordinate conjunction joining the clause "that nation might live" to "gave." The second "that" is an adjective, definitive, and belongs to "nation."
2. "That we should do this" is a substantive clause used as the subject of "is."
3. "Dedicated" is a past passive participle with the construction of an adjective, and belongs to "nation." "Power" is a noun, the object of the preposition "above."
4. "Resting-place" is a noun used as the subject of the verb understood, belonging to the subordinate conjunction "as".
5. The clause, "All men are created equal," is a substantive clause used in apposition with "proposition."
6. "Years" is objective without a governing word expressed, or the object of a preposition understood.
7. "Testing" is a present active participle with the construction of an adjective, and belongs to "war." It might be used in an expanded form as a finite verb.
8. (a) "The man who works faithfully succeeds;" "who works faithfully" is an adjective clause, joined by the relative pronoun "who." (b) "There is much discussion about who wrote Shakespeare;" "who wrote Shakespeare" is a substantive clause, used as the object of the preposition "about." (c) "When we arrived at the place where our friends live we were well supplied with provisions;" "when we arrived at the place" is an adverbial clause, joined by the conjunction "when;" (d) "Where our friends live" is an adjective clause, joined by the relative adverb "where," and, of course, modifies "place." (e) "It is said that wisdom is better than gold;" "wisdom is better" is a substantive clause used as the subject of "is said."

These sentences are said to be complex, because they contain dependent clauses.

PHYSIOLOGY.

1. State what you can about a cell as to size, shape, and parts.

2. Why is the skull made up of several curved bones? Name the bones of the cranium.

3. What is the difference between an involuntary muscle and a voluntary muscle? Name one of each kind.

4. Discuss the red corpuscles of the blood as to form, size, origin and function.

5. Why is there a pulse in arteries and none in the veins? Discuss fully.

6. What is the function of the skin? How may the skin be kept in a healthy condition?

7. What is the largest gland in the body, and what are its functions?

8. How may a stroke upon the ear by a book or the hand injure that organ?

ANSWERS.

1. Cells are microscopic in size, variable in shape, the typical ones being spherical, and consist of protoplasm and a nucleus.

2. To fit to and protect the brain. Occipital, Parietal, Temporal, Ethmoid and Sphenoid.

3. An involuntary muscle is under the control of the reflex centers, a voluntary muscle is under the control of the will. All the skeletal muscles are voluntary, all muscles of the digestive tract are involuntary.

4. Red corpuscles are disk shaped, or biconcave in form, $\frac{1}{3500}$ in. in diameter. They probably originate in the ductless glands, red marrow of bones, and in the capillaries. They carry the blood gases.

5. Arteries are always completely distended with blood making their walls tense. The impulse of the ventricles in forcing blood into them starts a wave along the arterial wall which rapidly passes to their periphery and is there broken by the widely extended capillary system.

   There is no pulse in the veins because they are not in position to receive directly the impulse of the ventricles and moreover are never fully distended.

6. To protect the tissues immediately beneath, to eliminate waste, and to regulate temperature.

7. The liver. Its function is to secrete bile and to produce glycogen.

8. It might rupture the membrano Tympani.

GEOGRAPHY.

1. Name and give the locations of the bounding lines of the zones.

2. What causes limit the distribution of plants?

3. What is the general direction of oceanic currents in the torrid zone? Why?

4. Describe a forty-acre tract of land in accordance with usual form, making a deed for the same.

5. What are the more prominent of Indiana's exports?

6. Describe the drainage systems of British America.

7. Why is the climate of Western Europe different from that of Eastern America in similar latitudes?

8. What circumstances tend to make centers of population in different countries?

9. Bound Italy and give some of its most important products.

10. What forms of government are found in the countries of South America?

ANSWERS.

1. Torrid zone, Tropic of Cancer 23½, degrees N. Latitude, and Tropic of Capricorn, 23½ degrees S. Latitude. N. Temperate, Tropic of Cancer and the Arctic circle, the latter 66½ degrees N. Latitude. N. Frigid, Arctic circle, S. Temperate, Tropic of Capricorn and the Antarctic circle, the latter 66½ degrees S. Latitude.

2. Climate, natural barriers, and the preoccupancy of area by other species.

3. a. Westerly. b. Rotation of the earth, and inertia.

4. The N. W. ¼, of the N. W. ¼, of section 10, Township 4 north, Range II east.

5. Hay, corn, wheat, coal, lumber and building stone.

6. The head waters of the Yukon, the Mackenzie's system draining north into the Arctic, the Hudson Bay system, the St. Lawrence system and the Pacific system.

7. Eastern America is washed by cold currents of water, Western Europe by warm currents of both water and air.

8. In general terms the natural features, more particularly the products and facilities for trade.

9. a. France, Switzerland, Austro Hungary, the Adriatic and the Mediterranean Seas.

   b. Wheat, corn, cattle, fruits, marble, sulphur, silks, and wines.

10. Republics and Colonial forms.

HISTORY.

(*Answer any seven.*)

1. What characteristics, if any, of the New England people do you attribute in whole or in part, to the physical features of their country?

2. What do you consider to have been the greatest mistakes ever made by our nation in its attitude toward other countries? Explain.

3. Why should we teach to pupils the time of an event? The place of an event?

4. What seems to you the one memorable fact in the founding and developing of the colony of Rhode Island? Explain.

5. What was the "National Road," and in what way was it a factor in the politics of the nation?

6. What motive seems to you to have been the dominating one of each one of the nations,

respectively, that established colonies in America?

7. What historic event of the Revolution is especially suggested by each of the following names: Burgoyne, Arnold, Allen, Henry, Jefferson? Describe one of the events.

8. What characteristics, if any, of the people of the Southern States do you attribute chiefly to the fact that the region is more favorable to agriculture than to other occupations?

9. Explain the differences that had to be harmonized before it was possible to make and adopt the present constitution.

10. Name the person who, in your estimation, has been the wisest statesman this country has produced, and trace his part in some historic movement.

ANSWERS.

1. Their shrewdness and skill in invention. A community so situated as to be capable of a diversity of industrial interest is always more intellectual than one not so favored. New England is peculiar in this respect. A vast variety of the raw materials of production, unlimited water power available to work these up into finished products, and excellent facilities for transporting these products to proper markets, combine to favor the intellectual development of its people. The rugged and diversified scenery has doubtless had much to do with the sturdy independence of its people, and their love of fair play.

2. The Mexican War.

3. Because time and place are fundamental parts of our thought about any event.

4. Toleration in all matters pertaining to the religious convictions of its people.

5. A graded and macadamized road from Cumberland, Md. to Wheeling, Va., with an extension through Ohio. It was built chiefly under Monroe's administration, and served the purposes of the trunk line railways of to-day.

6, The extension, in every case, of their own commercial and political power.

7. Burgoyne, his surrender at Saratoga, N. Y., Oct. 17, 1777; Arnold, his treason, in 1780; Allen, the capture of Ticonderoga, N. Y., in 1775; Henry, his speech in the Virginia Assembly, in 1765; Jefferson, the writing of the Declaration.

8. The simplicity of their intellectual virtues. The South is great in nothing but law and war.

9. The jealousies naturally existing between small states and large ones; between industrial systems of different kinds, slave labor and free labor, manufacturing communities and agricultural.

10. Such questions cannot be answered. George Washington, John Marshall, Abraham Lincoln,—according to the mood I happen to be in, and the part of our history that happens to be in my mind's eye at the time I try to answer the question. So far as we can make it out, had it not been for Washington, independence would not have been secured; without Marshall, the Constitution would have been ineffective even in theory, and without Lincoln, in fact. Yet, doubtless, had not the country found these particular men, when its necessities came, it would have found others who would have served it with equal loyalty and ability.

DAVID COPPERFIELD.

1. Describe the school life of David Copperfield.

2. Characterize Uriah Heep.

3. What grade of social life is chiefly pictured by Dickens in this book? Illustrate what you mean by references to the text.

4. Sketch briefly the characters of "Dora" and "Agnes," and indicate their parts in the story.

5. Describe the Murdstone family.

6. What seems to you to be the purpose of the story? Illustrate or justify your statement.

ANSWERS.

1. David's first experience as a school-boy was acquired at Salem House, a boarding-school kept by a cruel, ignorant man who took fiendish delight in the suffering of the miserable, half starved children entrusted to his care. Here, living in constant dread of a caning, abused and mistreated in every conceivable way, it is no wonder that David learned very little, indeed, little did the poorly paid teachers care whether the boys learned anything or not. One of the most important features of the year spent with Mr. Creakle was the formation of David's friendship for James Stearforth, who played so grave a part in after years.

   When he next assumes the character of pupil it is at Canterbury under the guidance of good, old Dr. Strong: kind and generous even to a fault, he inspired David with new ambition and noble motives. Under these fortuitous circumstances he advanced from the lowest form to that most exalted position "head-boy", when his school days proper were at an end.

2. Uriah Heep—with the name comes a vision of a tall, lank figure, high-shouldered and bony, clad in decent black, buttened high up to the throat. A long, skeleton hand strokes the chin while a pair of reddish brown eyes, unprotected by either lashes or brows, peer at me from such a cadaverous face that an involuntary shudder creeps over me. And as the creature writhes and smiles in exaggerated humility I seem to hear his favorite expression, "I am so very humble, you know."

   A hypocrite, without an equal, cruel and cunning, worming his way into the confidence and lives of benefactors only to betray their trust, he is certainly, the meanest, most contemptible character in fiction,

3. The principal characters in David Copperfield are taken from neither the highest nor the lowest ranks, but are a sort of respectable middle class, most of them struggling with financial troubles. For illustration of this fact, study the characters of Betsy Trotwood, Mr. Wickfield, Mr. Micawber, Mr. Murdstone, and Dora's father.

4. A pretty, silly, loving child, shrinking in terror from all reason and responsibility, this is Dora, David Copperfield's "child-wife." By her utter dependence and helplessness, the strong, manly traits of David's character, latent up to this time, are brought forth as they could have been by nothing else, fitting him for the fuller, higher life of his later years which were to be passed with his good angel, Agnes. Her very name carries with it the calm, soothing influence which her presence always diffused, like the soft light shining through the stained glass of a church window. A woman, strong, helpful and wise, by whose counsel David was guided from his early boyhood, and to whom, after the death of Dora, he naturally turned for that comfort and help which it was her highest pleasure to give.

5. The Murdstone family proper, comprised but two, Mr. Murdstone and his sister Jane. Mr. Murdstone, in appearance was exceedingly dignified and stern, with dark hair and keen, cruel, black eyes ever on the watch for some wrong-doing of David or his unhappy mother, whose gentle loving spirit rendered her particularly susceptible to her husband's tyranny. A selfish, calculating villian, he won by flattery the heart of David's mother for the express purpose of gaining possession of whatever property she might have. Not content with his own ability to torture her sensitive nature, he introduced as house keeper his most worthy sister. Jane Murdstone looked much like her brother, the same dark face, piercing eyes and mouth which shut up like a steel trap. The one adjective which most accurately expresses both her appearance and disposition is—metallic. She was in every respect a metallic woman. Two more cruel, cold, heartless characters it would be difficult to find.

6. The original purpose of Dickens was undoubtedly to write an autobiography, but as he wrote the plan of a novel unfolded itself before his mind and with some modifications and enlargement we have the result in the story of David Copperfield. The "Life of Dickens" justifies this view of the case.

SCIENCE OF EDUCATION.

(*Answer any five.*)

(These questions are based on the Reading Circle work for the current year.)

1. What do you regard as the true spirit of the teacher, that is, he should be prompted mainly by what motives in doing his work?
2. Give three reasons why the teacher of any grade or subject must be a constant student in order to do efficient teaching.
3. "As is the teacher so is the school." Show several important applications of this principle.
4. Suggest some of the things that may be done for the dullard, that will enable him to make the most out of his school life.
5. What things may an intelligent teacher do to hold the attention and interest of the two or three brightest pupils, usually found in a school?
6. What is the purpose of supplementary reading in the grades?

ANSWERS.

1. By the one motive, to fit his pupils for making the most out of their lives, as the teacher himself understands what life is.

2. If one does not grow, he cannot teach; if he is not a student, he cannot grow. Then, if he is not a student, he cannot teach.

3. If the teacher is disorderly, he cannot maintain order in his school. If he loves sham work, his pupils will soon come to do the same. If he is a student himself and loves his work, he will get his pupils to love theirs; since children always like to go where there is a good time.

4. There is no one so dull that he does not have an interest in something. The teacher should be able to discover what the dull pupil does take an interest in, and should help him do good work in that particular thing. This may lead on to all others.

5. He can give them special work in connection with the general work of the class, and in this way practically put them into a class of their own.

6. To get fuller information upon a given subject, and to give deeper interest in that already obtained. No complete view of any subject can be obtained from any single statement of the subject. Even the same person would state the matter differently at different times and places. There are few subjects of which a complete view can be obtained at one time and one place by one person; and completeness of view is the end that should be aimed at by the teacher and the pupil alike.

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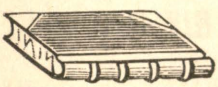

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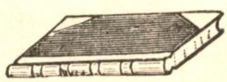

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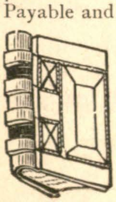

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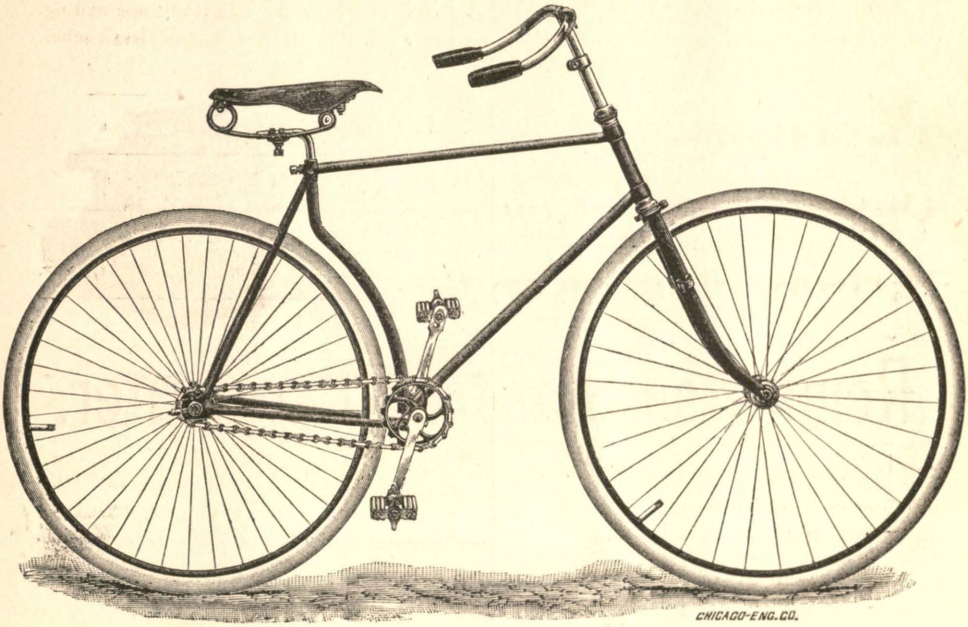

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